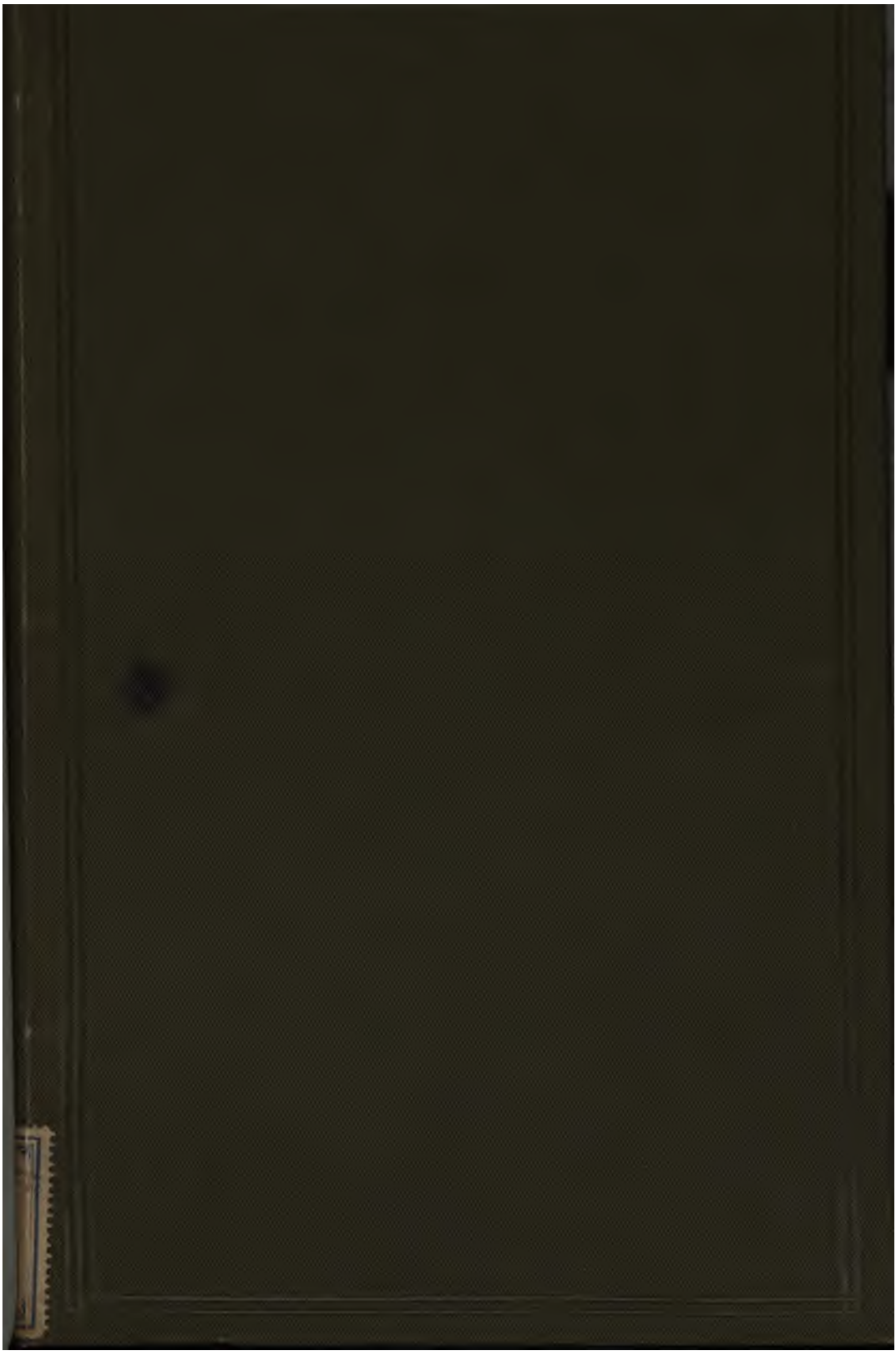

International Exhibition

PARIS 72.

1878.

# COAL AND IRON

## in all countries of the World.

Compiled from official sources and
with the assistance of eminent living authorities
by

**J. Pechar,**
*Railway Director*
in Teplitz
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LONDON: SIMPKIN, MARSHALL, & CO., STATIONERS' HALL COURT, E.C.

# INDEX.

# GENERAL REMARKS.

THE invention of Bessemer steel marked the approach of a new era, the forerunners of which were to be found at the four last universal exhibitions. It may be said to have dawned at Vienna only about five years ago, and now the age of steel has indeed not only fully risen upon the world, but that material is everywhere striving for the mastery with iron.

We are witnessing at present one of those great revolutions by which man has always risen to a higher state of civilisation. By the prehistoric remains lately discovered we have been enabled to acquire a clear perception of the successive periods of human development, extending over an incalculable number of thousands of years. Crude tools, made of flint, wood, bones, staghorn, &c., are the indications of the first period of human culture; afterwards we perceive how the stone, by dint of grinding and polishing, acquired a shape more and more approaching that of the present tool. The revered recesses of the grave have also preserved for us the remains of former ages, which prove that bronze was discovered during the age of stone, and that an age of bronze tools and weapons then followed. Both kinds of implements were in use at the same time, perhaps during thousands of years, the wealthier class using the metal, the poorer class the stone, until the latter was at length entirely discarded. By a similar change, at the beginning of historic ages bronze was driven out of use by iron; and at present an event of similar importance is being repeated before our eyes, with this difference only, that in consequence of the present advanced state of science and mechanical appliances the period of transition is considerably shortened.

It is but ten years since the more prudent of railway managers began to replace the old iron rails by steel ones. At the time of the Vienna Exhibition, when this change was going on steadily, the Cologne-Minden Railway had laid down some hundred and eighty miles of steel rails, and they had also been introduced on the extensive State lines in Alsace-Lorraine and Austria. There were then still many new lines of railway projected to work with iron rails. But since that time the change has been one of unparalleled dimensions. Following the example of England, France, and Russia, nearly all railway authorities in Europe have ere this resolved to replace the iron rails by steel ones, and the days of the former are consequently numbered.

A number of recent events, which may turn out beneficial in one way and disastrous in another, has further increased the importance of this change. In

the first place, we mean the present commercial crisis, which, after five years' existence, has extended more widely and has been productive of more misery than any other disaster of its kind during the present century. The prices of iron and coal especially have fallen with a surprising rapidity, and to an extent without precedent in the annals of commerce. This was the necessary consequence of the undue increase of prices during the years 1872 and 1873.

At present the value of pig-iron has reached the average of 1860 to 1870, and the nominal market price of Scotch pig-iron has fallen from £5 16s. 11d. per ton in 1873 to £2 9s. 6d. in 1878. The consumption, which, by the over-speculation of the preceding years and the consequent increase of prices, had been restricted, was again revived by the fall. But ironmasters, in England as in America, in Austria as well as in Germany, must ascribe this disaster chiefly to their own want of foresight, for the works had been enlarged beyond all reason. Thus, for instance, Prussian official statistical records show an increase of ironworks in that country from the year 1870 about equal to the whole number erected up to that time from the beginning of this century. The lesson thus taught by the evil consequences of a reaction, necessarily proceeding from a state of excessive competition, ought to be taken to heart the more seriously, because, on the one hand, the temptation to enlarge the old or establish new works is at the present time very strong, in consequence of the facilities afforded for the easier raising of capital and the great technical improvements of our day; and on the other hand, the risk of enforced alteration of the works, resulting from new inventions, is now much greater than before.

Even since the Vienna Exhibition several inventions and improvements likely to exercise great influence on the future of the iron and steel trade have made their appearance.

It would be beyond our province to refer now more particularly to the process invented by SIEMENS and MARTIN, at present the most important rival to BESSEMER'S invention. Now, however, Dr. SIEMENS, one of the authors of this process, and president of the British Iron and Steel Institute, has effected a further improvement at his Landore Works, by adding to the molten cast-iron ores of great purity, instead of the iron or steel scrap hitherto used in the Siemens-Martin process. According to a communication made by Mr. BRAMWELL late president of the Institution of Mechanical Engineers, at the Royal Institution of London, in the beginning of 1877, the following are the principal peculiarities and advantages of this so-called *Landore* process: The molten cast-iron and the ores, on being mixed together in one of Siemens's patent regenerating gas furnaces, react on each other, and the carbon of the cast-iron and the oxygen of the ore combine with the effect of decarbonising the cast-iron and deoxydising the ore. The result is liquid wrought-iron, containing scarcely a trace of carbon. From time to time a test is taken from the furnace to judge if the conversion is complete. At the right moment an exact quantity of spiegeleisen is added, by which the fluid iron is converted into steel. By taking tests during the operation the workman is enabled to obtain with certainty the desired quality of steel. This is an essential advantage of this method compared with Bessemer's

process. Owing to improved methods of manufacture, and particularly to the use of pure ores from Spain and Algeria, Bessemer steel is certainly a much more trustworthy material now than it was ten years ago, when it contained more phosphorus and fractured very easily; still even now the inequality of its composition has been the greatest impediment to the introduction of steel rails. This defect of not being entirely master of the quality of different Bessemer ingots—many of them being more brittle than intended—is entirely avoided by the Landore process, by which the steel can be made as soft as may be desired.

The Admiralty test for steel requires that the test pieces, each 8 inches in length, shall be capable of an elongation of twenty per cent before fracture; and further, that after being heated and then tempered in cold water they shall be bent to three-fourths of their thickness without receiving damage. Out of 14,000 samples subjected to these tests at the Landore Works, near Swansea, not one of them failed to fulfil these requirements.

Whereas Bessemer steel is, on account of its uncertain quality, very exceptionally or never used for such purposes where its unreliable character might imperil human life—as in the case of railway bridges and shipbuilding—the English Admiralty has already ordered no less than eight men-of-war to be built of Landore steel. Mr. BRAMWELL characterised the difference between the two processes by the following remarkable words: "In employing the Bessemer process reliable results can only be expected when it is in the hands of skilful men with a thorough knowledge of their work. In the Siemens's process, on the contrary, great ingenuity would be required to make the result untrustworthy." Some impediment to a more general introduction of this process appears to be the cost of manufacture and the necessity of using ores of great purity only. In a paper read at the meeting of the Iron and Steel Institute at Newcastle (September, 1877), Dr. SIEMENS informs us that he is continually endeavouring, at his Birmingham and Towcester works, to bring the question of direct production of iron and steel from the ore to a definite solution, and the meeting declared his process to be a step in the right direction. On the same occasion Mr. I. LOWTHIAN BELL, M.P., described a method of eliminating the phosphorus from Bessemer steel by the application of oxide of iron whilst strongly agitating the metal at a low temperature. Mr. BELL is opposed to Dr. SIEMENS'S process, and decidedly in favour of the present blast furnace and the Bessemer converter. The success of his invention would certainly go a good way towards enabling these latter to retain their popularity. The experiments of both gentlemen, being conducted independently of each other, though contemporaneously, will certainly sooner or later remove the last obstacles that are still in the way of a cheaper and more general production of steel of the requisite quality and durability.

As soon as the entire removal of the phosphorus during the manufacture or the casting of steel is accomplished, or as soon as Dr. Siemens shall have reached his goal—a cheaper Landore process—a reason for delaying the general introduction of another improvement, which promises to be of the greatest importance to

railway concerns, will no longer exist. We mean the adoption of iron sleepers. The above-mentioned fact that Bessemer rails sometimes prove too brittle, and the fear that the consequent danger of fracture would be considerably augmented by the use of iron sleepers, is the greatest obstacle to the more general introduction of the latter. This danger would be entirely obviated by using a softer and more ductile steel. Even now, however, this improvement is considered to be of such importance that the Prussian Minister of Commerce, in the spring of 1877, directed the managers of the Royal State Lines to henceforth use iron sleepers exclusively. Their advantages are twofold: their use would effectually check the increasing and very injurious devastation of forests, and at the same time would effect a considerable economy, as timber sleepers are more expensive in the long run than iron ones, especially as the present low prices of iron greatly reduce the difference in first cost, which is in favour of timber. A considerable saving of material is effected by the shape of the sleepers, their section being similar to that of channel-iron. Moreover, patents were taken out towards the end of 1877 for a novel design of sleepers, to which the rails are fixed in such a manner as to effect a saving of 40 per cent in the weight of the latter.

Another circumstance promises to increase still more considerably these advantages by imparting to the sleepers a nearly unlimited durability. We allude to the process for completely *preventing the oxidation of iron*, invented by Professor BARFF, of London, and communicated to the Iron and Steel Institute during the winter of 1876–77. It is well known that the efficient preservation of iron against rusting is at present only provided for in cases where human life would be endangered by failure, as in the case of railway bridges and steamers. Thus, for example, at Mr. Cramer-Klett's ironworks at Nuremberg every piece of iron used for his bowstring bridges is dipped in oil heated to eight hundred degrees. The very great care which is at present taken in this matter may be judged from the current practice of most bridge and roofing manufacturers. Every piece of iron before being riveted in its place is cleaned from rust by being immersed in a solution of hydrochloric acid. The last traces of free acid having been cleared away, at first by quicklime and afterwards by a copious ablution with hot water, the piece is immediately immersed in hot linseed oil, which protects every part of the surface from the action of the atmosphere. Afterwards it is riveted and painted.

Notwithstanding all this, the painting requires continual and careful renewal. On the Britannia Bridge, near Bangor, the painter is permanently at work, yet, in spite of all this care and expense, rust cannot be entirely avoided. The age of iron railway bridges is still too short to enable us to draw conclusions as to the probabilities of accidents. Now, Professor Barff has discovered a process by which iron may be kept from rusting by being entirely coated with its own sesquioxide. A piece of iron exposed to the action of superheated steam, in a close chamber and under a certain pressure, becomes gradually covered by a skin of this black oxide, of a thickness depending upon the temperature of the steam and the duration of the experiment. For instance, exposure during five hours to steam superheated to five hundred degrees will

produce a hermetical coating capable of resisting for a considerable time the application of emery paper and of preserving the iron from rust even in a humid atmosphere, if under shelter from the weather. If the temperature is raised to 1,200 degrees, and the time of exposure to six or seven hours, the skin of sesquioxide will resist every mechanical action, and the influence of any kind of weather. The sesquioxide being harder than the iron itself, and adhering to its surface even more firmly than the atoms of iron do to each other, there is an increased resistance not only to chemical but also to mechanical action. The surface is not altered by the process in any other respect, a plain forging retaining its roughness, a polished piece its smooth surface. If the skin is broken away oxidisation takes place, but only just on the spot from which the oxide has been removed. If Professor Barff's experiments are borne out by practice, this invention may become of very great importance. It is within the bounds of probability that it may enable iron, by increasing its facility in competing with wood, to recover, at least for a considerable time, even more than the ground it has lost by the extraordinary extension of the use of steel. Iron is already being used for building purposes to a large extent; but oxidation once thoroughly prevented it will be able to take the place of wood and stone to a still greater degree. Iron roofing may be made quite as light as that of wood, and of greater strength, by a judicious arrangement and use of T iron.

Our opinion that the present depressed state of the iron trade is only of a transient nature appears to be justified by all these circumstances, and it is still further strengthened by the following considerations. In the first place, it is a fact that since the outbreak of the crisis the railway companies have been more tardy in the renewal of the superstructures than compatible with a regular service, and that they will soon be obliged to recover these arrears. Secondly, it is equally true that recent improvements and experience in the construction of railroads are tending to facilitate the extension of local branch lines and secondary railways, the completion of which should take at least the same time as that required for the construction of the present network of trunk lines. The laying down of local railways has as yet not made such progress as would seem desirable, because, in consequence of various circumstances, they have only in very few instances been made remunerative. One of the chief impediments (existing, however, only where a system of private railways prevails) has been created by the fact that the promoters of such enterprises naturally secured at first only the routes passing through populous and manufacturing districts, and being accordingly the most likely to afford good returns.

The capital for the remaining lines might be raised by the aid of guarantees and other sacrifices on the part of the State, the province, or the different corporations and public bodies concerned. In the case of Government railways, however, the surplus of the better paying lines might be employed to cover the deficit of the others, and on this account, as also on account of the more extensive means at disposal, a more complete system of railways may be expected from State enterprise than from that of private companies. Now there is every prospect

(in consequence of the international treaties and of the general direction in which railway politics in different countries are tending) that, at least in Europe, the system of State lines will eventually prevail—perhaps exclusively—and for this reason a considerable activity in this quarter may be expected.

On the other hand, the recent experience and great technical improvements bear even more directly on the economical construction of secondary lines. Another great obstacle in the way of local lines on the Continent was a traditional reluctance to depart from the English mode of railway construction, in accordance to which the great international lines of Europe have been laid out. This system was based on the supposition that all railways would want a second line of rails to meet the exigencies of their future traffic, and that the permanent way ought in each case to be prepared to carry express and heavy goods trains. Now, many local lines will never experience this necessity, and many others will do so only after such a lapse of time that an entirely new line could have been built by the interest that has been lost on account of the cost of the double line and permanent way. It was, however, generally understood at a comparatively early date that the permanent way of a branch line might be advantageously constructed for a single line of rails, but it was only in later times that engineering improvements have brought about the conviction that local railways may be constructed more cheaply than hitherto. When these lines are worked by light engines only—provided light loads and moderate speeds are agreed to—steeper gradients and sharper curves may be adopted, and thus a number of cuttings, tunnels, embankments, and bridges may be avoided, and the superstructure, especially the rails, may be of a much lighter type. We are speaking here only of lines of the normal gauge, and purposely omit all reference to narrow-gauge lines. Experience has proved the working expenses of narrow-gauge engines to be disproportionate in accordance with the well-known fact that smaller steam engines consume more fuel per horse-power than larger ones. Further, there is a waste of time and money in consequence of the discharge and reloading at unavoidable junctions with wide-gauge lines.

As soon as peace is again secured the iron and steel trades will recover in a short time from the depression occasioned by the crisis of 1873. But the revolution brought about by the predominant application of steel will not only continue but steadily acquire greater dimensions, until the use of iron will, in most cases, be entirely supplanted by steel. The introduction of a system of iron permanent way for railways, instead of wood sleepers, and the completion of the network of local railways, are opportunities which appear to have been accorded to ironmasters by a friendly fate, with a view to afford them time to recoup themselves for the outlay upon the present works previous to undertaking the manufacture of steel. The demand for iron and steel will be further increased for a long time to come by the numerous projects of new canals and improvements of rivers, which are at present actively pursued on the continent of Europe, and which have greatly stimulated the supersession of animal power by steam power for towing purposes. The demand for iron and steel for ship-building must also increase, seeing that iron and steel vessels continue to

replace and must eventually supersede wooden ones. It is true that there remain still two-thirds of the inhabited world, and even almost the larger half of Europe, in which these changes have still to be effected; nevertheless iron and steel manufacturers will do well to take timely measures for regulating the production in accordance with the demand by some action of their own, rather than suffer this to be brought about again by a violent commercial crisis, occasioning a partial cessation of the demand, ruinous prices, and consequent failures. This danger threatens the iron and steel trades more, perhaps, than it does any other industry, because their principal staff of life, iron ore, is not only comparatively abundant, but its carriage to places that have exhausted their own supply is getting daily cheaper on account of the increased facilities for shipment. A more serious danger to this branch of metallurgy would no doubt be an undue rise in the price of *coal*.

The commercial crisis and the preceding over-production, which was thought to have principally crippled the iron trade, has, since our last report on the Vienna Exhibition, affected the coal trade in a scarcely less degree. After hundreds of blast furnaces have been blown out and so many industrial establishments have either come to a standstill or been forced to reduce very materially the extent of their operations, the prices of coal, which like those of pig-iron had risen to an undue height, have fallen in the same proportion, but without as yet improving the demand. The welfare of the coal trade, however, is so entirely bound up with that of the iron trade and the railways, that it must share in the benefits of any revival of enterprise in those branches of industry. The prices of coal during the critical period proved to be in a singular way dependent on those of pig-iron, as will appear by the following comparison of prices in two districts which are certainly the most important in each trade :—

| | Yorkshire Coal. Medium Quality. | | | Scotch Pig-iron. | | |
|---|---|---|---|---|---|---|
| | s. | d. | | £ | s. | d. |
| December, 1871..... | 11 | 6 | per ton ..... | 2 | 18 | 11 per ton. |
| „ 1872..... | 23 | 0 | „ ..... | 5 | 1 | 10 „ |
| „ 1873..... | 24 | 6 | „ ..... | 5 | 16 | 11 „ |
| „ 1877..... | 10 | 4 | „ ..... | 2 | 14 | 4 „ |

The immense disturbances during the late period of speculation, the influence of which has been so disastrous for several years to the legitimate course of business, could not be exemplified better than by the change of prices as shown in this table. After a short period of feverish activity, quotations have settled again to their average level, and it is only to be hoped that they may never leave it again in like manner, for the loss sustained is far larger and far more general than any profit which could ever have been hoped for. As to the iron trade, we have stated our reasons for expecting a speedy return to prosperity, and a long duration of the same, always supposing that ironmasters will keep their production within reasonable limits. The case of the coal trade is to a certain degree the same. But there is some danger of the coal deposits of Western Europe becoming exhausted in the course of the next few centuries. The coal beds of Great Britain, at least, are estimated not to allow the same rate

of output for more than the next two hundred years, or at most for a third century, if mining operations at greater depths than hitherto should become possible in consequence of improved methods and appliances for sinking shafts.

We have no desire to discuss the question here as to whether it would not be beneficial to the interests of England, or even of all Europe, if the coalmines were purchased and worked by Government, for the purpose of enforcing economy in the use of coal by keeping up a higher price. This would certainly tend to prolong the supply from the existing deposits, and prevent excessive fluctuations of prices, as well as to obviate violent commotions and crises in the trade. If, however, we are willing to put up with fluctuating production and prices, the free and non-restrained action of the trade will certainly bring about the same result; for as soon as the English coal beds begin to get exhausted, prices will rise, and the opening out of new mines on the continents of Europe and America—chiefly in Germany, Russia, and the United States, where there are coal beds able to supply the present or even a greater demand for thousands of years—will become remunerative. The prospect for a still more remote future is certainly not a matter to trouble our present generation, which takes matters easy, and trusts in the advancement of natural science. Nevertheless this question bears in a certain degree upon our present condition, and it is not well to be entirely indifferent to it. Engineers are continually devising new coal-saving appliances. Stationary and even locomotive boilers are fired at present by a description of fuel which thirty years ago was thrown away amongst the *débris*. Saving of fuel, and increasing its useful effect, is a permanent task of the engineer. By a regular course of instruction, boiler-tenters in England and France have been trained to save an astonishing proportion of the usual average consumption of fuel. Premiums for the economical use of fuel, which it is now a general practice for railway companies to allow to their engine-drivers, are working in the same direction. A similar tendency may be observed in heating appliances for domestic purposes. These movements, however, generally progress too slowly to keep pace with the increase of population and the demands of commerce. The consumption of coal far outruns the march of economy.

But discoveries and inventions likely to bring about a sudden revolution are not wanting either. We have witnessed one of the latter during the last fifteen years, on the occasion of the rapid and general introduction of petroleum. There cannot be any doubt that the erection of new gasworks has decreased on account of the use of petroleum—a change which must, of course, affect the coal trade too.

Another improvement tending to economise our store of coal is the better utilisation of water-power which may be expected in the future, as the use of this power seems to have been in its infancy until now. At present we cannot enumerate all the improvements and projects for obtaining motive power from water to a more considerable extent than hitherto; but we may recall to memory that Mr. SIEMENS's invention of transmitting motive power to great distances by electro-magnetism—which was brought forward for the first time at the Paris Exhibition of 1867, and by which a better use of waterfalls and

currents is made possible—seems to be more than a mere scientific toy, and has already reached the stage of a practical trial.

But even if we take no notice of such projects for the future, and only keep in sight inventions proved by practice, we find plenty of matter for reflection. Thus, for example, GRAMME and SIEMENS'S electro-magnetic machines bid fair to effect a radical change in the matter of lighting.

According to calculations, the chief results of which have been published in *Dingler's Polytechnischen Journal*, this machine-made electric light, compared to gas light, may be produced of an illuminating power six times greater, but in the long run at a cost 33 times less than the latter. Up to the present the electric light has only been introduced into a small number of works in Paris and Mülhausen, at some goods stations and ports, in the Vienna ice skating rink, and at some French ironworks. One of Siemens's dynamo-electric machines has been tried on board the steamer Faraday, while at anchor off Gravesend, the light being equal in intensity to 4,000 to 6,000 candles. The machine was worked by a special engine on board. The light of the lamp was directed towards the shore, which was illuminated in such a manner, that at some 400 yards distance a written letter could be easily read. At sea the lamp is fixed to the masthead, and thus not only makes the ship visible to other craft, but also renders objects at sea perceptible to the people on board, allowing at the same time any kind of work to be done on deck. In several Paris factories, where particularly good light is required, night-work has become possible only by the introduction of the electric light. The results obtained up to the present are sufficient to assure us that not only in factories and public institutions but also in the lighting of entire towns gas-light will be entirely superseded. This will effect a saving of coal, which is certain to be sensibly felt by the trade. It is true steam engines are employed generally to work the electro-magnetic machines (recently further improved by Jablochkoff, a Russian scientist), but the quantity of fuel required for them bears no comparison to the quantity of coal consumed in the manufacture of gas.

All these facts point to the conclusion that however soon a return to an ordinary state of affairs may be expected, even greater caution is needed in the coal than in the iron trade as regards establishing new undertakings, if a repetition of former disasters is to be avoided.

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In concluding these general remarks, and before turning to the different countries of our globe which are deserving of special consideration as far as regards their production or consumption of coal and iron, we append two tabular statements, showing the increase of the production of mineral fuel and of pig-iron all over the world which has taken place during the last ten years. A summary statistical return of the present manufacture of Bessemer steel, and another tabular statement of the railway system of all parts of the world, and of the state of the merchant navies of the seafaring people, will be given afterwards.

## PRODUCTION OF COAL THROUGHOUT THE WORLD.

| Countries. | Production. | | | | Percentage of increase. |
|---|---|---|---|---|---|
| | Year. | Metric Tons. | Year. | Metric Tons. | |
| Great Britain | 1866 | 103,069,804 | 1876 | 135,611,788 | 31·57 |
| Germany | „ | 28,162,805 | 1877 | 48,296,367 | 71·48 |
| France | „ | 12,234,455 | „ | 16,889,201 | 38·04 |
| Belgium | „ | 12,774,662 | 1876 | 14,329,578 | 12·17 |
| Austro-Hungary | „ | 4,893,933 | „ | 13,362,586 | 175·08 |
| Russia | „ | 271,533 | 1875 | 1,709,269 | 529·49 |
| Spain | „ | 432,664 | 1876 | 706,814 | 63·36 |
| Italy | „ | 70,000 | 1875 | 102,140 | 45·91 |
| Sweden | „ | 36,467 | 1876 | 92,352 | 153·25 |
| Other Countries of Europe. | ... | ? | ... | 80,000 | ? |
| United States | 1866 | 21,856,844 | 1875 | 48,273,447 | 120·85 |
| Canada | „ | 558,519 | 1876 | 709,646 | 27·06 |
| Other Countries of America | ... | ? | ... | 400,000 | ? |
| Asia | ... | ? | ... | 4,120,000 | ? |
| Africa | ... | ? | ... | 100,000 | ? |
| Australia | 1866 | 774,000 | 1876 | 1,380,000 | 78·29 |
| Total | ... | 185,135,686 | ... | 286,163,188 | ... |

## PRODUCTION OF PIG-IRON THROUGHOUT THE WORLD.

| Countries. | Production. | | | | Percentage of increase. |
|---|---|---|---|---|---|
| | Year. | Metric Tons. | Year. | Metric Tons. | |
| Great Britain | 1866 | 4,596,279 | 1876 | 6,660,893 | 44·92 |
| Germany | „ | 1,000,492 | „ | 1,614,687 | 61·38 |
| France | „ | 1,260,348 | 1877 | 1,453,112 | 15·30 |
| Belgium | „ | 482,404 | 1876 | 490,508 | 1·68 |
| Russia | „ | 314,850 | 1875 | 426,896 | 35·59 |
| Austro-Hungary | „ | 284,638 | 1876 | 400,426 | 40·68 |
| Sweden | „ | 230,670 | „ | 351,718 | 52·48 |
| Luxemburg | „ | 46,460 | „ | 231,658 | 398·62 |
| Spain | „ | 39,254 | 1873 | 42,825 | 8·92 |
| Italy | „ | 22,200 | 1875 | 20,278 | ... |
| Other Countries of Europe. | ... | ? | 1876 | 60,000 | ? |
| United States | 1866 | 1,225,031 | 1877 | 2,351,618 | 91·96 |
| Other Countries of America | ... | ? | ... | 115,000 | ? |
| Asia | ... | ? | ... | 60,000 | ? |
| Africa | ... | ? | ... | 30,000 | ? |
| Australia | ... | ? | ... | 15,000 | ? |
| Total | ... | 9,502,626 | ... | 14,324,619 | ... |

The *production of coal throughout the world* amounted in 1876, according to the tabular review immediately preceding, to about 286,000,000 metric tons. If we leave out of view America (the United States excepted), Asia and Africa, for which countries reliable statistical returns for previous years are not available, an increase of about 52 per cent appears to have taken place within the years between 1866 and 1876. The greatest share of the total production falls to the lot of

| | Metric Tons. |
|---|---|
| Great Britain, with a production of..... | 135,611,788=47·4 % |
| Then follow | |
| Germany, . „ „ ..... | 48,296,367=16·9 „ |
| And the United States, „ ..... | 48,273,447=16·9 „ |

The next in order are France, Belgium, and Austro-Hungary. The largest percentages of increase within the time specified are exhibited by Austro-Hungary (=175·08%), and the United States (120·85%). If Russia and Sweden are left out of consideration, on account of their insignificant quantities, the lowest percentages are those of Belgium (12·17%) and Great Britain (31·57%).

The *production of pig-iron all over the world* amounted in 1876 to 14,300,000 metric tons. It has advanced from 1866 in an equal ratio with the production of coal, the increase during this time being about 47·8%. The preponderance of England is also in this case apparent, the British production being 6,660,893 metric tons, or 46·5% of the total production of the world. The countries next following are—

| | | | | |
|---|---|---|---|---|
| The United States, with..... | 2,351,618 | metric | tons, | or 17·1 % |
| Germany with ..... | 1,614,687 | „ | „ | 11·3 „ |
| France with ..... | 1,453,112 | „ | „ | 10·2 „ |

The largest percentages of increase are shown by the United States (=91·96%), Germany (61·38%), and England (44·92%), if Luxemburg and Sweden are left out of consideration.

The present state of the manufacture of Bessemer steel all over the world is shown by the following table :—

PRODUCTION OF BESSEMER STEEL.

| Countries. | No. of Bessemer Works. | No. of Converters. | Metric Tons of Steel produced. | Percentage. |
|---|---|---|---|---|
| Great Britain..... | 25 | 114 | 762,000 | 36·1 |
| United States ..... | 11 | 27 | 534,412 | 25·3 |
| Germany ..... | 18 | 81 | 390,434 | 18·5 |
| France ..... | 7 | 26 | 218,000 | 10·4 |
| Austro-Hungary ..... | 13 | 32 | 97,470 | 4·6 |
| Belgium ..... | 2 | 12 | 75,258 | 3·6 |
| Sweden ..... | 19 | 38 | 22,138 | 1·1 |
| Russia..... | 2 | 4 | 8,636 | 0·4 |
| Total ..... | 97 | 334 | 2,108,384 | 100·0 |

According to this, 97 Bessemer works, having an aggregate number of 334 converters, exist at present in the world. The total production of Bessemer steel is 2,100,000 metric tons, Great Britain again having the largest share of it (=36·1 %) ; the next following countries are the United States, Germany, and France.

As the development of the railway system is in every country most intimately connected with the state of the coal and iron trade, some statistical returns concerning it will be of interest.

## GEOGRAPHICAL AND GEOLOGICAL CONDITIONS.

Great Britain's coalfields extend over an area of nearly 7,000 square miles (more than 1,800,000 hectares), of which about 72 per cent are in England, 26 to 27 per cent in Scotland, and the remainder of 1 to 2 per cent in Ireland.

The number of pits in operation was :—

| | | | Eng. Tons. |
|---|---|---|---|
| In 1854 | 2,397 | pits, yielding | 64,000,000 |
| In 1857 | 2,867 | „ | 65,000,000 |
| In 1860 | 3,009 | „ | 83,700,000 |
| In 1863 | 3,160 | „ | 87,600,000 |
| In 1872 | 3,850 | „ | 123,000,000 |
| In 1875 | 3,933 | „ | 130,900,000 |
| In 1876 | 4,002 | „ | 132,900,000 |

In the returns for 1876 the number of producing districts appears to be 22, in 4 of which less than one million tons are raised, 8 raised over a million and less than 5, other 4 between 5 and 10, and the remainder between 10 and 20 million tons, as follows :—

| | Eng. Tons. |
|---|---|
| South Durham | 19,410,295 |
| Yorkshire | 15,054,634 |
| North Durham and Northumberland | 12,579,964 |
| South Wales | 11,972,825 |
| Scotland (East) | 11,667,150 |
| South Staffordshire and Worcestershire | 10,080,637 |
| West Lancashire | 9,124,611 |
| North and East Lancashire | 8,264,648 |
| Derbyshire | 7,025,060 |
| Scotland (West) | 6,997,605 |
| Monmouthshire | 4,499,793 |
| Staffordshire (North) | 4,077,374 |
| Nottinghamshire | 3,414,757 |
| North Wales | 2,207,156 |
| Cumberland and Westmoreland | 1,401,543 |
| Gloucestershire | 1,257,600 |
| Shropshire | 1,054,009 |
| Leicestershire | 1,004,957 |
| Warwickshire | 884,712 |
| Somersetshire | 650,387 |
| Cheshire | 587,792 |
| Ireland | 124,931 |

The number of coalpits in the several districts does not by any means stand in an average proportion to the respective total output. For instance, among the large coal districts in the North of England, South Durham figures with 185 mines and raises 19,000,000 tons ; North Durham, with 183 pits, only 12,000,000 tons. Leicestershire, with a small number of pits, produces more coal than Warwickshire with a larger number. Nottinghamshire raises three times as much coal as Somersetshire, although the number of its pits exceeds the latter by three only. Nor does the increase or decrease in the number of mines necessarily signify an increase or decrease of production. In the North the number of pits increases, while the production becomes less, and in Lancashire the number decreases, although the production rises.

Among the coal-producing districts the great Northern coalfield in Durham and Northumberland has ever been the most important. From the reign of

Queen Elizabeth to the beginning of the present century, even the southern counties, London included, depended for their coal supply chiefly upon this district. But since that time the production in the other districts has also enormously increased; and upon this progress the railways and canals which have been constructed to the coal districts have exercised an extraordinary influence. As a matter of course, there have occurred many changes in the production of the different districts even during the last decade. Scotland and Wales, Yorkshire, Staffordshire, and Worcestershire especially, have increased their production very considerably since 1860, while some counties, as Shropshire and Cheshire, do not show the same growth. Ireland has constantly remained at its low figure of production.

Geographically, the coalfields are usually divided into four large groups, viz. :—

1. The coalfields of the North : Durham, Northumberland, Cumberland, and Scotland.

2. Those of the Midlands: Yorkshire, Derbyshire, Lancashire, Staffordshire, Worcestershire, Cheshire, Nottinghamshire, Leicestershire, and Warwickshire.

3. Those of the West: South Wales, and the smaller basins in the South.

4. The coalfields of Ireland.

With regard to geological features, however, this division can scarcely be maintained, neither can it be so with regard to the quality of the coal produced in the various districts. In respect of their importance the groups range in the following order :—

1. *Durham and Northumberland.*—This district alone contributes nearly one quarter of the total output of coal in Great Britain. Situated on the east coast, south of the boundary of Scotland, it extends over a length of 80 and a maximum breadth of 32½ kilometres, comprising an area of about 1,140 square kilometres. Here, between the Tyne and the Wear, lie the Wallsend coals, generally preferred for domestic use; north of the Tyne the dense engine coal; in the west an excellent coking coal, particularly adapted for the blast furnace. This coalfield contains, on an average, twelve seams, of a total thickness of 12 to 18 metres. The position of the seams is not unfavourable for winning, the covering strata being of a solid nature, necessitating but little timbering in many cases. But there lie yet many seams so deep that the sinking of pits becomes too expensive, and the removal of water, which often appears in great quantity, imposes great difficulties upon the working and sinking of these mines.* Firedamp also frequently occurs. The mechanical appliances for ventilation, winding and pumping, as well as all plant employed above and below ground, are well known to be here in a high state of perfection, and the labour market in this part is also generally more favourable than in most other mining districts.

The situation of this coal district near the sea, contiguous to the ports of Newcastle, Sunderland, Hartlepool, the excellent appliances for loading and unloading on the Tyne, the active maritime commerce with about 80,000 sailors solely engaged in the coasting trade of the northern coal ports, are circumstances which have enabled the Durham and Northumberland district to take the first rank in the supply of coal for home use as well as for abroad. On an average fourteen to fifteen million tons of coal are shipped here annually. Besides this a very extensive industry has been developed in the neighbourhood, comprising especially the working of blast furnaces and rolling-mills, the construction of ships, locomotives, and machine tools, the manufacture of glass and chemicals of every description, particularly of soda, &c.

* Lately the Chaudron system of sinking shafts through aqueous strata has been employed, for instance at Whitburn.

In the basin of Durham and Northumberland the output of coal was :—

| | | |
|---|---|---|
| In 1854 | 15·2 million Eng. tons | = 100 % |
| In 1864 | 22·9 million Eng. tons | = 151·3 % |
| In 1870 | 27·3 million Eng. tons | = 179·9 % |
| In 1876 | 31·8 million Eng. tons | = 210·4 % |

2. *Yorkshire and Derbyshire.*—Nearly in the centre of England, with a slight inclination towards the west, this field stretches over a length of 105 and a breadth of 11 to 33 kilometres between Leeds and Nottingham, covering an area of about 1,290 square kilometres. The average thickness of coal is about 14 metres, comprising from 10 to 16 seams, of 1·5 to 2·6 metres thickness. Among them is to be found the renowned South Yorkshire coal, the black shale of Derbyshire, and the Kilburn coal, so much preferred for domestic use. This district has not so large a share in the coal export as Northumberland and Durham, but finds its principal market in the highly developed industry of the midland counties. The production was :—

| | | |
|---|---|---|
| In 1854 | 7·5 million Eng. tons | = 100 % |
| In 1870 | 14·9 million Eng. tons | = 198·7 % |
| In 1876 | 22·0 million Eng. tons | = 294·7 % |

3. *Scotland.*—The district extends, although with very variable thickness of seams, and often interrupted by faults and the appearance of plutonic rocks, from the eastern coast of Scotland around the Firth of Forth to the west coast, near Ayr. Glasgow may be taken as its industrial centre. In the west, that is in Ayrshire and Lanarkshire, there is the famous gas coal, and also cannel, much sought after for blast furnace use. The number of seams varies. The "Great Seam," in which, however, many faults occur, or which at any rate has not been found in all localities, attains a thickness of 2·2 to 3·2 metres. In some places there exist as many as 12 seams, varying in thickness from 0·6 to 1·5 metres, as for instance in the rich Midlothian basin to the east of Edinburgh. The enormous Scotch iron manufacture, originating in the neighbouring deposits of the well known "Blackband" ironstone, is the chief consumer of the coal produced in this district. The production was :—

| | | |
|---|---|---|
| In 1854 from 367 collieries | 7·6 million Eng. tons | = 100 % |
| In 1870 from 411 collieries | 14·9 million Eng. tons | = 201·3 % |
| In 1876 from 482 collieries | 18·6 million Eng. tons | = 252 % |

4. *Wales, Monmouthshire, Gloucestershire.*—The southern coalfields of Wales are the most important of this district. They extend over 1,450 square kilometres, and contain (mostly at great depths—as much as 600 metres), 8 seams, and in certain places as many as 15 and 18 seams, with a total thickness of 5·5, 8·5, and 22·5 metres. The coal of Aberdare, which is almost smokeless, is in much request as steam coal. Cardiff and Swansea are the principal shipping ports, but the greatest part of the produce is consumed in the large Welsh iron, tin, and copper works. Here, however, the best seams are supposed to be nearly exhausted.

The coal district of North Wales (also called the coalfield of Denbighshire), situated on the north east of Wales, yielded in 1860, from 39 coalpits, 1·1 million tons; in 1869 from 31 pits, 1·4 million tons; and in 1876, 2·2 million tons.

The Monmouthshire coal basin (yielding in 1876 4·5 million tons) is usually reckoned with the coalfields of Wales, on account of a certain similarity in their geological formation.

The same is sometimes the case with the coalfields of Gloucestershire, in the vicinity of Bristol and Bath. Geologically this can hardly be justified, as from its stratification this district resembles more the Belgian than the English type. Most troublesome faults occur, and the thickness of most seams is usually but

small. An exception to this is the small basin of the Forest of Dean, containing 11 seams, of a total thickness of over 8 metres. The production of Gloucestershire amounted in 1876 to 1·27 million tons.

The yield of the two largest basins (those of South Wales and Monmouthshire) in this group was :—

| | | |
|---|---|---|
| In 1854 | 8·5 million Eng. tons | =100 % |
| In 1864 | 10·9 million Eng. tons | =129 % |
| In 1870 | 15·5 million Eng. tons | =183·7 % |
| In 1876 | 16·4 million Eng. tons | =194·2 % |

5. *Lancashire.*—The area of this district is only to be taken at about 360 square kilometres. The seams are not very thick, except in the vicinity of Manchester, where there are as many as 16 seams with a total thickness of 20·5 metres of coal. In consequence of a rather faulty stratification the working of the mines is carried on under much difficulty. This, however, is amply counterbalanced by the generally superior quality of the coal. The well-known cannel belongs to this district. To this must be added the circumstance that, besides a considerable iron trade, the district forms the centre of the English cotton industry. The principal places—Manchester, Liverpool, Bolton, Rochdale, Oldham, &c.—need only be named in order to carry the conviction that this gigantically developed industry must create an enormous demand for mineral fuel. The position which the port of Liverpool occupies in the English coal trade is equally well known. The production was :—

| | | |
|---|---|---|
| In 1854 | 9·1 million Eng. tons | =100 % |
| In 1870 | 13·8 million Eng. tons | =152·2 % |
| In 1876 | 17·3 million Eng. tons | =191·3 % |

6. *Staffordshire, Worcestershire, Cheshire.*—North Staffordshire is usually classed together with Cheshire, and South Staffordshire with Worcestershire. This corresponds to their respective markets, and also, to a certain degree, with the geological formation of the coalfields. The northern part of this group includes a great many seams, which in some places attain a total thickness of 30 to 42 metres. Over these seams the well-known Blackband ironstone is often found; above this the large clay beds upon which the earthenware and pottery manufacture of England is based. In Cheshire are the large salt mines, which form the foundation of the immense chemical industry of Great Britain. In South Staffordshire and Worcestershire the number of seams is not so large as in the northern district, but the thickness of some of them is all the more considerable, reaching from 8 to 11 metres. As a rule the coal does not lie so deep as in most other districts; the sinking and plant are therefore less costly than in the north, and hence the surface of the coalfields is covered with shafts and chimneys. But it is said that these mines are, in consequence, worked in a less economical manner than in the north. The coal finds a ready consumer at home in the large iron trade of the "Black Country," with its blast furnaces, foundries, forges, rolling mills, and similar industrial establishments, ever enveloping the district in a cloud of smoke and coal dust; and on the other hand numerous railways and canals amply provide for the transport of the coal to more distant parts. The production was :—

| | | |
|---|---|---|
| In 1854 | 8·3 million Eng. tons | =100 % |
| In 1870 | 14·2 million Eng. tons | =171·4 % |
| In 1876 | 14·7 million Eng. tons | =177·4 % |

7. *Nottinghamshire, Leicestershire, and Warwickshire.*—These belong geographically to the coal basins of the midland counties, and are geologically not

very different from the coalfields of Yorkshire and Derbyshire. In the year 1860 there existed in Nottinghamshire 21 coalpits, in Leicestershire 14, and in Warwickshire 17. In 1869, the three counties had 26, 10, and 16 pits respectively, or a total of 52 pits. The production has been :—

| | | |
|---|---|---|
| In 1854 ..... | 1·2 million Eng. tons | =100 % |
| In 1869 ..... | 2·9 million Eng. tons | =241·6 % |
| In 1876 ..... | 5·3 million Eng. tons | =450 % |

8. *Cumberland and Westmoreland.*—Situated in the north-west of England, this coalfield extends about three kilometres under the sea (St. George's Channel, between England and Ireland), and is about 48 kilometres long and 9 kilometres broad. As regards the thickness of the seams and the quality of the coal, it is far behind the neighbouring districts of Durham and Northumberland. The Cumberland coal, for instance, is not suited for coking, in consequence of which coal is imported from the Durham district for the Bessemer furnaces and for steel making generally. Whitehaven is the seaport of the district. The output of coal was :—

| | | |
|---|---|---|
| In 1854 ..... | 0·9 million Eng. tons | =100 % |
| In 1870 ..... | 1·4 million Eng. tons | =155·5 % |
| In 1876 ..... | 1·4 million Eng. tons | =155·5 % |

9. *Shropshire, Somersetshire, and Ireland.*—These districts have a still smaller production, and their trade scarcely exceeds the local requirements ; at least, not in the same degree as the districts mentioned above. In the year 1873 considerable beds of hematite ores were discovered in Shropshire, which have somewhat increased the importance of the existing coalfields, although the latter are already nearly exhausted.

## BROWN COAL (LIGNITE) AND PEAT.

The great heating power and available quantity of coal has caused the existing lignite, or brown coal, and the peat fields to be neglected, which, under the circumstances, may be correct from an economical point of view. Some isolated cases excepted, English brown coal is of an inferior quality, and does not admit of even a distant comparison with the excellent quality found in the famous north-western basin of Bohemia. The best known source of lignite is the basin of Bovey, in Devonshire, which has been worked for the last 100 years, and contains 10 seams, of a total thickness of about 30 metres. Lignite is also found near Bothfield, Heathfield, Downholme, and Hudswell, in the county of Sussex; in Ireland near Lough Neagh (3 seams with a total of 10 metres), Ballintoy (7 metres), and Bally Macadam ; in Scotland, at the mouth of the river Brora ; on the isles of Skye and Wight, and in other places.

Extensive peat layers exist in the Scotch highlands, and also particularly in Ireland, where it is often somewhat difficult to know where peat ends and brown coal begins. It is mostly these deposits which are used in the application of peat, or the earthy turf-like brown coal, to the manufacture by distillation of paraffine and stearine, of photogen and solar oil.

## TOTAL PRODUCE OF COAL IN GREAT BRITAIN.

The older returns relating to the output of coal often differ, because many statistical compilations do not take into account the amount consumed in raising coal and water and for the purposes of the works generally, but refer only to the *quantity of* coal brought to the market.

In the following table the total amount of coal brought to the surface, including, as far as can be ascertained, the consumption at the collieries themselves, is stated :—

| Year. | Eng. Tons. | Value in £ Sterling. | Year. | Eng. Tons. | Value in £ Sterling. |
|---|---|---|---|---|---|
| 1840 | 34,026,108 | (?) | 1865 | 98,088,441 | 24,537,600 |
| 1850 | 44,612,271 | (?) | 1866 | 111,442,332 | 25,407,635 |
| 1854 | 64,658,644 | 15,000,400 | 1867 | 104,309,393 | 26,125,145 |
| 1855 | 64,266,742 | 16,123,200 | 1868 | 102,948,982 | 25,785,289 |
| 1856 | 66,456,703 | 16,563,800 | 1869 | 107,506,683 | 26,856,889 |
| 1857 | 65,232,717 | 16,348,650 | 1870 | 109,035,284 | 27,607,798 |
| 1858 | 64,846,814 | 16,252,100 | 1871 | 117,264,793 | 35,205,608 |
| 1859 | 71,813,965 | 17,949,900 | 1872 | 123,492,050 | 46,311,143 |
| 1860 | 83,923,814 | 20,010,674 | 1873 | 127,011,331 | 47,631,280 |
| 1861 | 85,458,001 | 20,908,800 | 1874 | 124,937,925 | 45,849,194 |
| 1862 | 83,457,962 | 20,409,500 | 1875 | 131,861,285 | 46,163,486 |
| 1863 | 88,119,641 | 21,573,000 | 1876 | 133,470,478 | 46,670,668 |
| 1864 | 92,904,012 | 23,197,900 | | | |

For the years immediately preceding 1840 there are numerous returns available which relate to production and sale in different coalmining districts. There is, for instance, information as to the entry of coal into London, the shipment from various ports, the yield of some mines, &c., reaching nearly as far back as the year 1700. Taking these as a basis, an attempt has been made to estimate the production for the years previous to those in the preceding table. Such figures, however, must be received with caution. When we have to deal with statements collected from works numbered by thousands, and relating to objects dealt with in millions of tons in weight and millions of pounds sterling in value, inaccuracies become inevitable, and therefore, however carefully these figures may have been compiled, they are not absolutely but only approximately correct. The further back we go, however, the more we have to resort to guesswork, or work upon some rule of probabilities. Even the production stated for the years 1840 and 1850 must be accepted with reserve, although the possible errors cannot be great. English statistics on coal are much more reliable since the year 1854.

For the increased percentage of production, the following results deducted from the table are given. The production has increased (the initial number of every period being taken as 100 per cent) :—

| | In Weight to | In Value to |
|---|---|---|
| From 1854—1860 | 129·8 % | 134·1 % |
| „ 1854—1870 | 168·6 % | 184·0 % |
| „ 1854—1876 | 206·4 % | 311·1 % |
| From 1860—1870 | 129·6 % | 138·0 % |
| „ 1860—1876 | 159·1 % | 233·2 % |
| From 1870—1876 | 122·5 % | 169·1 % |

Since the year 1840 the production of coal in England has been approximately quadrupled; since 1857 it has doubled. A proper conception of the quantity can hardly be expected by merely mentioning the enormous figure of over 130 million tons.

The produce of a single year would be sufficient to enclose England and Wales along the whole sea coast on the south, east, and west, and on the north along the Scotch frontier with a wall 4 metres high and 1 metre thick. The same mass formed into a column of 50 metres diameter would reach such a height that in our latitude it would be covered with perpetual snow.

## QUALITY OF THE COAL.

As already stated, the quality of the English coal is very variable according to the districts and even the different pits. Inferior sorts having only a moderate heating power are by no means absent; nor are earthy or stony coals unknown, nor such qualities which easily crumble to fragments or decay under the influence of the atmosphere. Generally, however, the better sorts are largely in excess, and all the various requirements which coal must fulfil according to the use to which it is to be put are satisfied in the highest degree by the English "black diamonds." Nor is it probable that another country exists in which the proper use of coal is so well understood as here. Every coal-master has acquired an exact knowledge, either from his own experience or from the information supplied by the consumer, whether his coal is most suitable for domestic use or for generating steam, whether it is better for use in gas making or for blast furnaces, or whether it is more valuable as fuel for steam vessels, and, finally, whether its structure and solidity fit it for exportation. Every branch of industry, every peculiar method of heating, makes different demands upon the coal. The English coal trade satisfies them all, for among the many thousand different sorts and qualities there have always been found such that would satisfy the most exacting, if reasonable, demands. Below are the analyses of 16 of the better classes of coal:—

## CHEMICAL ANALYSES.

| Description of Coal. | In 100 units of weight of *dried* coal were contained: | | | | | | In 100 units of weight of coal without ashes were contained: | | | | Quantity of Hydrogen. | | Name of Analyst. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Carbon. | Hydrogen. | Oxygen. | Nitrogen. | Sulphur. | Ashes. | Carbon. | Hydrogen. | Oxygen. | Nitrogen. | Available | Non-available | |
| | | | | | | | | | | | Compared to that of Carbon=100. | | |
| 1 West Hartley (Nth) Round Coal .... | 84·53 | 5·70 | 5·05 | 1·29 | 0·08 | 3·35 | 87·54 | 5·90 | 5·23 | 1·33 | 58·02 | 9·36 | Grundmann. |
| 2 Newcastle (North) Best Coal ..... | 84·31 | 5·09 | 7·24 | 1·49 | 0·13 | 1·73 | 85·92 | 5·18 | 7·38 | 1·51 | 47·39 | 12·94 | ,, |
| 3 Newcastle (North) Cannel ..... | 86·17 | 5·81 | 3·71 | 1·14 | 0·07 | 3·11 | 88·99 | 6·00 | 3·83 | 1·18 | 60·36 | 7·03 | ,, |
| 4 Seaton (North) Steam Coal .... | 78·65 | 4·65 | 14·21 | .. | 0·55 | 2·49 | 80·54 | 4·76 | 14·70 | .. | 36·17 | 22·84 | Dick. |
| 5 Low Main Seam (North) ..... | 78·69 | 6·00 | 10·07 | 2·37 | 1·51 | 1·36 | 81·01 | 6·17 | 10·38 | 2·44 | 56·41 | 19·75 | Taylor. |
| 6 Sunderland (Nth) Nuts ..... | 74·94 | 5·12 | 5·15 | 1·33 | 0·77 | 12·66 | 86·59 | 5·98 | 5·95 | 1·54 | 58·27 | 10·77 | Grundmann. |
| 7 Forge Coal (North) | 82·72 | 5·24 | 6·35 | 1·49 | 0·26 | 3·95 | 86·35 | 5·47 | 6·61 | 1·57 | 51·56 | 11·83 | ,, |
| 8 Hartlepool (North) Nuts ..... | 74·75 | 4·90 | 10·72 | 1·14 | 0·75 | 7·74 | 81·69 | 5·36 | 11·74 | 1·21 | 45·77 | 19·82 | ,, |
| 9 Grimsby (S. Wales) Engine Coal .... | 82·26 | 5·73 | 7·41 | 1·34 | 0·17 | 3·08 | 85·02 | 5·93 | 7·66 | 1·39 | 56·40 | 13·14 | ,, |
| 10 Ellvein (S. Wales) Coal ..... | 82·56 | 5·36 | 8·22 | 1·65 | 0·75 | 1·46 | 84·42 | 5·48 | 8·40 | 1·70 | 49·98 | 14·93 | Noad. |
| 11 Dowlais (S. Wales) Coal ..... | 89·33 | 4·43 | 3·25 | 1·24 | 0·55 | 1·20 | 90·93 | 4·51 | 3·30 | 1·26 | 43·33 | 6·27 | Riley. |
| 12 Wolverhampton Coal ..... | 78·57 | 5·29 | 12·88 | 1·84 | 0·39 | 1·03 | 79·88 | 5·34 | 13·02 | .. | 46·75 | 20·52 | Vaux. |
| 13 Wigan (Lanca.) Cannel ..... | 84·07 | 5·71 | 7·32 | .. | .. | 2·40 | 85·81 | 5·85 | 8·34 | .. | 52·91 | 15·26 | Regnault. |
| 14 Ayrshire (Scotl.) Coal ..... | 76·08 | 5·31 | 13·33 | 2·09 | 1·23 | 1·96 | 78·59 | 5·49 | 13·77 | 2·15 | 44·53 | 25·52 | Rowney. |
| 15 Elgin (Scotland) Splint Coal .... | 80·63 | 6·16 | 10·61 | 1·33 | 0·84 | 1·43 | 82·50 | 5·28 | 10·68 | 1·36 | 45·58 | 18·12 | ,, |
| 16 Boghead Cannel .. | 61·04 | 9·22 | 4·40 | 0·77 | 0·32 | 24·23 | 80·90 | 12·48 | 5·60 | 1·02 | 44·03 | 10·23 | Matter. |

Interesting are the experiments* made by the German Admiralty at the naval station of Wilhelmshafen, on the heating power and the utility of English coals, and especially those sorts suitable for steamers, as compared with Westfalian coals. It was not a question in these experiments of deciding whether English coals were suitable for the German navy. This question had already been answered in the affirmative by the fact of the German war vessels having up to that time used them exclusively. The question to be answered was whether the best German coal would be equal to the English. These trials have not been carried out in a laboratory with small selected samples, but practically, on a large scale, with a marine boiler, and each sort has been tried under exactly the same circumstances. They are therefore in the highest sense of the word reliable for comparison. Of the English, as well as the Westfalian coals, those were selected which were known to be the most suitable for the purpose, and we give in the following table the principal results.

Experiments on English and Westfalian steam coal for the navy :—

| Description of coal. | Weight per cubic metre of broken coal. | Unconsumed residue, consisting of ashes and clinkers. | Relative cohesion. | Heating Power. | | | Time during which smoke was emitted. |
|---|---|---|---|---|---|---|---|
| | | | | Per hour and per square metre of grate surface | | Each kilo. of coal evaporated water of 0°. | |
| | | | | Coal burnt. | Water of 0° evaporated. | | |
| | Kilos. | % | % | Kilos. | Kilos. | Kilos. | Minutes. |
| English..... 1 | 720·1 | 10·048 | 51·60 | 81·47 | 705·82 | 8·655 | 5-5½ |
| „ ..... 2 | 746·3 | 10·012 | 48·08 | 89·41 | 755·76 | 8·452 | 5-6½ |
| South Wales 1 | 729·7 | 7·213 | 46·26 | 110·43 | 922·14 | 8·350 | 5-6 |
| „ 2 | 741·8 | 10·129 | 49·76 | 104·57 | 833·8 | 7·973 | 5-7 |
| „ 3 | 837·3 | 7·219 | 46·90 | 103·03 | 831·5 | 8·072 | 5-7 |
| „ 4 | 744·66 | 5·604 | 48·80 | 109·6 | 921·9 | 8·412 | 5-6 |
| Westfalian 1 | ... | 3·910 | ... | 92·4 | 808·4 | 8·748 | 3-4 |
| „ 2 | 724·0 | 3·250 | 35·90 | 79·6 | 684·1 | 8·595 | 1½ |
| „ 3 | 745·8 | 7·340 | 40·56 | 93·95 | 798·7 | 8·502 | 3-4 |
| „ 4 | 720·2 | 7·162 | 47·56 | 91·70 | 687·5 | 8·432 | 1-2 |
| „ 5 | 752·5 | 5·107 | ... | 79·37 | 674·7 | 8·498 | 2 |
| „ 6 | 737·92 | 6·160 | 33·52 | 88·40 | 751·5 | 8·500 | 4-5 |
| „ 7 | 716·48 | 6·38 | 34·66 | 88·0 | 741·6 | 8·420 | 4-5 |
| „ 8 | 762·5 | 8·692 | 42·88 | 92·38 | 793·9 | 8·156 | 4-5 |

This extract shows that the Westfalian coal is superior to the English as regards heating power, quantity consumed, proportion of ashes, and time during which smoke is emitted. As regards the relative cohesion, however, the Westfalian coal appears to be inferior to the English, which, however, does not apply to the Upper Silesian coal, this description being, according to the same trials, superior in this respect to the English as well as the Westfalian coal.

## LABOUR.

The number of hands directly engaged in coalmining in Great Britain was 413,344 in 1872, and 422,000 in 1875. Indirectly, however, the coal trade occupies a very much larger number, inasmuch as the people engaged in the enormous transport of coal on railways, canals, and vessels, must be added; and

* These trials, so far as they referred to other than English and Westfalian coal, were not of decisive authority. What has been said above of Westfalian coal has long been proved in practice.

besides these, there are a great number of carriers, machinists, smiths, shipwrights, and others, who owe their occupation to this trade.

The English workman, generally speaking, has a strong constitution. His food, of which meat and other substances containing proteine compose the largest proportion, affords him, under normal conditions of wages, &c., full restitution of his expended energy, and in physical services he surpasses, on a general average, nearly all the workmen of the European continent, perhaps also those of the other parts of the world. Although often grown up without any schooling, and therefore possessing only very little or no theoretical knowledge, he is sufficiently intelligent soon to understand thoroughly the work which is confided to him. Above all, he possesses in a high degree a practical eye and a ready judgment as to how certain work may be carried out in the easiest and best manner, and yet exactly according to given requirements. The grand concentration of the branches of English industry, at which other countries have not yet nearly arrived, has been largely instrumental in attaching to many industrial establishments, and metallurgical or mining concerns, a race of workmen who, until lately at any rate, did not, without stringent necessity, leave the situations occupied by their fathers before them for several generations. The industries have the further advantage of the labour of the rising generation, which begins to work at the earliest possible period of life. The English workman may be one-sided in so far as he is only fitted for one particular sort of work, and this skill is often only self-acquired; but in the right place he is more efficient than a workman of any other nation. Under these circumstances it is easy to see how the English industry, favoured with such excellent productive power, and with the aid of other favourable circumstances, has made a progress with which other nations have hitherto been unable to keep pace. These advantages have been highly beneficial to the success of coalmining.

During the last few years, however, a change has taken place in the condition of the English working classes which is now causing serious apprehension. The first beginnings manifested themselves about the year 1850, but since the termination of the Franco-German war in 1871 the differences between employer and employed have become much more acute. In the expectation of a long-continued peace, the trade of all countries—even that of North America, which was then urging on the completion of its railways with excessive haste—increased in a degree scarcely ever before witnessed. All prices rose, above all those of iron, for which there was then an enormous demand. The increased production of this commodity created a larger demand for coal, the price of which rose most rapidly. Then the colliers, encouraged by the example of their fellow-workmen in the iron trade, insisted upon the concession of their demands for higher wages, which had been urged for some years. No one will blame the working classes for attempting to improve their social condition as long as their demands are within the bounds of reason. We should not overlook the fact that the work in English coalpits is difficult and dangerous, more so than in most coalpits of Germany, Austria, France, and even of Belgium. The number of fatal accidents in English coalpits annually amounts to 1,050 or 1,100; in unfavourable years even much higher. On the average, for every 120,000 tons of coal raised one human life is sacrified. The great depth of the pits increases the dangers to which the colliers are exposed. The small thickness of some seams, which often necessitates his working in a reclining position, causes many hardships to the miner, which are not by any means diminished by the high temperature. As regards ventilation, and other mechanical appliances, many pits, especially those of smaller proprietors, are very deficient, because many English mining engineers, who have often risen from the pick upwards, without sufficient technical or professional education, are lacking, as a general rule, the ability for that scientific management which is nearly always found in the coalmines of Germany, Austria, and also of France.

Until the year 1870 the wages of colliers were but moderate. In the years 1865 to 1868 a pitman in the Durham and Northumberland district earned from 3s. 9d. to 4s. and 4s. 6d. per day of 12 hours; a hewer in ten hours 4s. 6d., 5s., and 5s. 6d. In Wales the wages averaged 12% to 15%, and in Scotland 10% to 12% lower. Although these are wages which have not been paid to coalminers of other countries, still we cannot but call them moderate, because, on the one hand, an English miner does more work, and, on the other hand, the necessaries of life are dearer, or, in other words, the purchasing power of the money is smaller.

When the ironworkers in 1871 had carried their demand for a rise of wages, the colliers insisted on a corresponding increase. But they did not stop here, nor were they satisfied when they obtained £2 in a week of four working days, or 10s. a day. As often as an opportunity could be found they had resource to that, in England only too well-known measure of striking; and just in the years of prosperity (1872-74) when wages were at their maximum, the colliers were more discontented and troublesome than they had ever been known to be before.

The great strike in South Wales, for instance, may be remembered, when about 60,000 out of the 65,000 hands engaged in the collieries and ironworks of the district struck work from the 1st December, 1872, to the middle of February, 1873, and caused the stoppage of 118 coalmines alone. The loss of production during this time has been estimated at 1,170,000 tons of coal, and the total cost of the strike to masters and men at about £2,000,000, the loss of wages alone amounting to £800,000. It is well known that the prosperity of the trade suddenly collapsed in the year 1873; and as sales went from bad to worse the price of coal had at last to follow the general current. From the year 1875, and still more from 1876, this reaction, as will be shown further on, affected the coal trade; and the beginning of 1878 finds it in an exceedingly unfavourable—not to say seriously endangered—position, not only in Great Britain, but also in all other industrial countries.

Step by step the English colliers have had to relinquish the advance on their wages, and at the present day nearly the same rate of wages is current in all districts as before the year 1870. During the summer of 1877 the coalminers of Durham and Northumberland earned 4s. 3d. to 4s. 9d. and 4s. 10d., the hewers 5s. to 5s. 3d. and 6s. per day, according to their individual efficiency. In Wales the wages were 4s. to 4s. 6d. for the ordinary pitmen, and 5s. to 5s. 3d. for hewers. Since that time the wages have still continued to decrease. But notwithstanding these reductions the former condition of things has not been restored. Intercourse with the workmen has become more difficult, and the increasing antagonism between employer and employed, as well as the feeling of uncertainty arising therefrom, are probably far more injurious than the rise of wages. It is much to be regretted that the efficiency of the hands has been deteriorated, that they use every opportunity for refusing to work, that they object to piecework, and reduce the number of working hours wherever and whenever possible—in one word, that they strive to obtain the utmost maximum wages for a minimum of labour.

If there ever was a time less favourable than another for demanding an increase of wages, or when strikes were imprudent and unjustifiable, it was the exceedingly dull period of trade during the year 1877. Nevertheless, not less than 191 large organised strikes occurred during that year in Great Britain, 21 of which were connected with the coal trade. The colliers of Soundersfort, in South Wales, for instance, went on strike for seven months for an increase of wages, and were at last obliged to resume work at the former rate of wages. The same was the experience of the miners of Fife and Clackmannan, who struck work for three months, and of those of Dodsworth and Dronfield, who were on strike for seven and seven and a half months respectively

## PRICES OF COAL.

Up to the year 1823 there was an export duty of 7s. 2d. per ton upon coal; in 1825 this duty was reduced to 4s., and during the years 1831-42 it amounted to 5 per cent of the value. In 1842 it was again fixed at 4s. per ton for foreign and 2s. per ton for English vessels, until the year 1845 brought the abolition of this troublesome and unjust tax. These remarks may precede the consideration of the price of coal in England, because so high an export duty cannot have been without influence on the price of coal before the year 1845.

In London the price of the best Newcastle Wallsend coal, which is most in request for domestic use, was as follows, inclusive of the tax, wharfage, and carriage—these items amounting to from 5s. to 7s. 3d. per ton:—

| | s. | d. | | s. | d. |
|---|---|---|---|---|---|
| In the year 1805 | 44 | 9 | In the year 1868 | 15 | 11 |
| „ 1810 | 51 | 8 | „ 1869 | 17 | 6 |
| „ 1820 | 42 | 11 | „ 1870 | 17 | 5 |
| „ 1830 | 36 | 4 | „ 1871 | 19 | 3 |
| „ 1840 | 23 | 7 | „ 1872 | 24 | 11 |
| „ 1850 | 17 | 1 | „ 1873 | 45 | 8 |
| „ 1860 | 20 | 1 | „ 1874 | 30 | 7 |
| „ 1865 | 20 | 2 | „ 1875 | 25 | 5 |
| „ 1866 | 17 | 9 | „ 1876 | 19 | 8 |
| „ 1867 | 18 | 3 | „ 1877 | 19 | 6 |

The highest price for Wallsend coal was paid in London on the 12th of February, 1873, viz., 52s. At the end of 1873 it had already fallen to 38s. 6d.

The other coals show a similar fluctuation of prices, although with different figures, according to quality and demand. But all without exception demonstrate the fact that between the year 1865 and about the middle of 1871 there were no great fluctuations in the coal market, while since 1871 the prices rose by bounds—being doubled within the space of 12 to 18 months—from 100 to 200 and 250 per cent; for some sorts it was even still higher.

In South Wales engine coal rose 112 per cent, and coke 162 per cent, from June, 1871, to March, 1873.

For Yorkshire, a comparison of prices at the end of the years 1871, 1872, 1873, and 1877, gives the following result:—

| | Dec., 1871. | Dec., 1872. | Dec., 1873. | Dec., 1877. |
|---|---|---|---|---|
| Best coal | 13s. 1d. | 23s. 10d. | 25s. 8d. | 11s. 2d. |
| Second quality | 11s. 6d. | 23s. 0d. | 24s. 6d. | 10s. 4d. |
| Third quality | 8s. 4d. | 20s. 2d. | 18s. 4d. | 7s. 2d. |

Coal for metallurgical purposes, which in 1870 was sold at 12s. 6d., could scarcely be obtained for 42s. 6d. at the beginning of the year 1873.

In order to ascertain the causes of this extraordinary enhancement of coal prices, and to consider if any and what measures might be adopted to reduce them to a normal level, the Coal Commission was appointed in March, 1873. The Commission completed its deliberations in twenty meetings, and reported the following as the most likely causes of the increase in price:—

1. The development of the English iron trade, principally caused by the increased demand from Germany and America, and also by the extension of the use of iron for shipbuilding purposes.

2. The increased consumption by all other branches of industry, but more especially the chemical and textile industries.

3. The thirteen weeks' strike in South Wales, in consequence of which the supply for the first time was exceeded by the demand.

4. The reduction of working hours, especially by the operation of the Mines Regulation Act 1872, limiting the working time of juveniles to twenty-four hours per week.

5. The rise of wages to such an extent, that in some mining districts the average pay amounted to £2 per week.

This was sure to be followed by a reaction, which began in the second half of the year 1873, continued until the end of 1874, and even, in a moderate degree, into the first half of 1875; from that time, however, in considerable bounds, so that at the end of 1877 the price of coal was lower than before the beginning of the rise. At the beginning of 1878, most of the English coalowners were selling at cost price, some even below it; and in spite of that, they found it very difficult to dispose of their output, in consequence of the depressed state of the iron industry, and owing to the increased production in countries which imported coal from England.

## THE COAL TRADE OF GREAT BRITAIN.

The greatest part of the large annual production of 130,000,000 English tons of coal remains and is consumed in Great Britain. Only about 11%, or ⅛ of the total production, is exported, while 89% is required for home use.

The total output of the year 1872 amounted to 123,600,000 tons, which was divided somewhat as follows :—

| | | | |
|---|---|---|---|
| For the iron industry | 40·0 | million English tons | = 32·4 % |
| For factories | 27·0 | million English tons | = 21·87% |
| For dwelling-houses | 20·2 | million English tons | = 16·36% |
| For gas and water works | 8·0 | million English tons | = 6·46% |
| For the mining industry | 7·9 | million English tons | = 6·38% |
| For steamers | 3·5 | million English tons | = 6·46% |
| For railways | 2·2 | million English tons | = 1·76% |
| For copperworks | 0·9 | million English tons | = 0·72% |
| For sundries | 0·9 | million English tons | = 0·64% |
| For export | 13·0 | million English tons | = 10·54% |
| Total | 123·6 | million English tons | = 100 % |

According to this table the gigantic English iron industry consumed nearly a third, or 32·4%, of the total output, while only a sixth, or 16·36%, served for domestic use.

The most ample means of transport at low tariffs aid the English coal trade, and facilitate the carriage of coal in all directions.

*Railways.*—The railway companies ever duly appreciated the advantages of a regular and copious traffic, such as afforded by the coal trade; accordingly no coal district is left without ample provision of branch lines. Since September 27th, 1825, when the first railway, the Stockton-Darlington line, was opened for public use, the railway system of Great Britain has increased in the following manner. The total length of British railways was :—

| | | | | | |
|---|---|---|---|---|---|
| In the year | 1840... 2,141 | kilometres. | In the year | 1871...24,755 | kilometres. |
| „ | 1845... 3,768 | „ | „ | 1872...25,460 | „ |
| „ | 1850...10,142 | „ | „ | 1873...25,892 | „ |
| „ | 1855...13,406 | „ | „ | 1874...26,472 | „ |
| „ | 1860...16,792 | „ | „ | 1875...26,870 | „ |
| „ | 1865...21,362 | „ | „ | 1876...27,380 | „ |
| „ | 1870...24,692 | „ | „ | 1877...27,540 | „ |

There is no other country, Belgium excepted, which possesses so large a railway mileage per head of population and per square mile of superficial area as Great Britain. This extension of the network of railways in Great Britain has exercised the most favourable influence on the utilisation of the coalfields. The whole island contains scarcely a place with a trade worth naming that has not been connected with the railway system. The competition between the different lines has long ago reduced the tariffs to the lowest level; and since 1860 the railways have even, and not without success, competed with the coasting trade, and more successfully still since 1875. Thus there were brought to London—

| | By Sea. | | By Railways and Canals. | |
|---|---|---|---|---|
| In the year 1863 | 3,282,512 | English tons | 1,763,637 | English tons. |
| „ 1864 | 3,067,490 | „ | 2,302,779 | „ |
| „ 1876 | 3,221,754 | „ | 5,096,173 | „ |
| „ 1877 | 3,221,754 | „ | 5,335,482 | „ |

As early as the year 1867 it was calculated that the quantity of coals carried by the railways was double that of all other goods. The most important lines engaged in coal traffic carried the following quantities of coal:—

| In the Year. | North-Eastern. | Midland. | London and North-Western. | Caledonian. | Lancashire & Yorkshire. |
|---|---|---|---|---|---|
| | Eng. Tons. | Eng. Tons. | Eng. Tons. | Eng. Tons. | Eng. Tons. |
| 1870 | 8,955,688 | 6,532,521 | 6,488,201 | 4,023,209 | 3,284,772 |
| 1872 | 16,029,073 | 9,313,219 | 11,027,727 | 5,636,433 | 4,233,972 |
| 1876 | 19,426,329 | 10,206,654 | 13,444,677 | 6,034,134 | 5,203,965 |
| 1877 | 19,141,239 | 10,637,301 | 15,272,334 | 6,334,234 | 5,306,500 |

| In the Year. | North British. | Great Western. | Great Northern. | Manchester, Sheffield, & Lincolnshire. | Glasgow and South-Western. | North Stafford-shire. |
|---|---|---|---|---|---|---|
| | Eng. Tons. | Eng. Tons. | Eng. Tons. | Eng. Tons. | Eng. Tons. | Eng. Tons. |
| 1870 | 3,907,064 | 3,683,640 | 2,121,541 | 2,096,350 | 1,690,201 | 546,130 |
| 1872 | 3,520,000 | 6,279,554 | 2,192,000 | 4,797,147 | 2,084,894 | 822,793 |
| 1876 | 4,558,208 | 10,678,307 | 2,696,780 | ... | 2,225,318 | 1,453,826 |
| 1877 | 4,693,058 | ... | 2,923,678 | ... | ... | ... |

*Rivers.*—There are no really large rivers in England. Even the Thames, as regards its length, watershed, and volume of water, occupies a secondary place when compared with most rivers of the European continent. This deficiency however, greatly diminished by the numerous bays on the coast, is almost entirely made up by the sea, whose tides penetrate into and convert shallow estuaries into magnificent harbours, and what would otherwise be mere streams into navigable rivers. Any remaining natural shortcoming, scientific engineering has remedied by means of well-planned and admirably executed works, such as canals, breakwaters, embankments, sea-walls, docks, and their appliances, &c. Forty years ago the Tyne at Newcastle was a shallow stream, scarcely navigable by vessels of 200 to 300 tons burden. Now science has taken advantage of the tides, and created a first-class seaport with a fine water-way, the shores of which are lined by coal-pits, and crowded with industrial establishments. Thus, as is

generally the case, the existence of coal, coupled with efficient means of transport, has stimulated and developed industrial activity to the highest degree.

*Maritime Commerce.*—At present English coal finds its way to nearly 900 ports. It commands nearly all coasts, and, entering the mouths of their rivers, penetrates far into the interior of foreign lands. The English coal trade looks upon the Baltic and the North Sea as its own dominion, in spite of the fact that German competition is rife. It supplies the coasts and much of the interior of France, traverses the Mediterranean, and advances eastward to the coasts of Turkey and Egypt. It also crosses the ocean to India, China, and other countries, by way of the Cape or Suez Canal, and supplies transatlantic countries, such as the West Indies, Central America, and Brazil.

The shipping interests of Great Britain and its coal trade are very closely connected. Coal is in itself a most important article of freight. The same coal which in Newcastle is purchased at 10s. per ton costs in Bordeaux 20s. to 25s.; in the Mediterranean ports as much as 30s.; and in transatlantic or transoceanic markets, 50s., 60s., and 70s. According to the distance it is carried, its market price rises six and sevenfold, and this increase of price represents nothing but well-paid labour incidental to transport by sea, which, besides this, may claim the merit of facilitating the home trade. In the year 1877 coal was exported to the value of £8,900,000. This sum—minus only a small amount for carriage from the pit to the port—was paid to the mine owners as interest on their sunk capital, as repayment of wages, and, according to the price obtained, as profit for their enterprise. The maritime commerce carries this coal to all parts of the world, and raises its value so as to double and treble it; thus attaining the same effect as though it had been increased in value by home industry. Coal becomes a much more valuable article by its mere transport to a distance.

The same coal plays, however, another and far more important part in the English shipping trade. It serves as ballast to ports which send their raw material to England in exchange for valuable manufactures of little bulk or weight. The freights are on that account much in favour of the English manufacturer, because to nearly all ports from which he imports his raw materials, coal, which has a value on its arrival, is taken as ballast. The superiority of the English industry is to a certain extent due to these low rates of freight created by the extended coal trade, their influence being similar to that of an export premium, and none the less powerful from being produced in a great measure by the sale of coal.

Thus the balance of English trade, which for the last few years shows an excess of import over export, which can scarcely be explained from a statistical point of view, assumes quite a different aspect if we add to the home value of the exported objects the very considerable increase of price which is caused by the transport to foreign countries, and, therefore, also due to English labour and capital.

The development of shipping during the last ten or fifteen years, shows, in most countries, a tendency to reduce the number of sailing vessels and to replace them by steamers. This fact, too, is favourable to the coal trade, for every increase in the number of steamers leads to an increased export of coal. As long as English coal commands the seaports, the numerous coal stations in all parts of the world will be chiefly, if not entirely, supplied with English coal. Germany and the United States are at present the only countries which might compete in the coal trade, but these states have to fulfil some important preliminary conditions before undertaking a task which, having regard to the favourable position of England, is by no means an easy one.

The following table shows in what manner the English merchant fleet has increased during the last few years. Great Britain possessed:—

| | Sailing Vessels. | | Steamers. | |
|---|---|---|---|---|
| | Number. | Tonnage. | Number. | Tonnage. |
| In the year 1160 | 25,663 | 4,204,360 | 2,000 | 454,327 |
| In the year 1870 | 23,165 | 6,993,153 | 2,426 | 1,651,767 |
| In the year 1873 | 20,832 | 5,320,089 | 3,061 | 2,624,431 |
| In the year 1875 | 20,538 | 5,383,763 | 3,002 | 3,015,773 |
| In the year 1877 | 17,765 | 5,526,930 | 3,133 | 3,283,910 |

All the sea-going nations of Europe, and the United States of America, possessed, in 1877, 51,921 sailing vessels of 14,799,139 tons, and 5,471 steamers of 5.507,699 tons.

Thus England, the "mistress of the sea," has more than half of all the steamers of the world, and a third of all the sailing vessels, under her flag.

As has already been mentioned, the export of British coal amounts to the eleventh part of the entire quantity raised. The export was :—*

| | | | |
|---|---|---|---|
| In the year | 1821 | 170,941 | Eng. tons. |
| „ | 1831 | 356,459 | „ |
| „ | 1841 | 1,497,197 | „ |
| „ | 1851 | 3,468,545 | „ |
| „ | 1856 | 5,879,779 | „ |
| „ | 1861 | 7,851,234 | „ |
| „ | 1866 | 9,953,712 | „ |
| „ | 1867 | 10,415,778 | „ |
| „ | 1868 | 10,837,804 | „ |
| „ | 1869 | 10,588,425 | „ |
| „ | 1870 | 11,504,272 | „ |
| „ | 1871 | 12,549,874 | „ |
| „ | 1872 | 12,991,253 | „ |
| „ | 1873 | 12,339,156 | „ |
| „ | 1874 | 13,927,205 | „ |
| „ | 1875 | 14,475,036 | „ |
| „ | 1876 | 16,299,077 | „ |
| „ | 1877 | 15,358,828 | „ |

The principal customers during the year 1861 were: America, 1,063,756 tons; France, 1,436,160 tons; Denmark, 542,567 tons; Hamburg, 514,427 tons; Prussia, 439,096 tons; Italy, 417,629 tons; Spain and the Canaries, 403,238 tons; Russia, 342,513 tons; Holland, 262,858 tons; Sweden, 214,004 tons; India, 199,069 tons; Turkey, 174,686 tons; Norway, 135,221 tons; Malta, 115,731 tons.

Since 1861 the quantity exported has considerably increased (from 7·8 million tons to 15·3 million tons), and the order in which the different countries stand as regards their coal import has also undergone a change. The *Economist* gives the returns of the Board of Trade on the export of coal and coke as follows :—

---

* To these quantities must be added the coal shipped for the use of steamers engaged in the foreign trade, viz. :—

| | | |
|---|---|---|
| In the year 1874 | 3,140,383 | Eng. tons. |
| In the year 1875 | 3,278,249 | „ |
| In the year 1876 | 3,564,524 | „ |
| In the year 1877 | 3,661,552 | „ |

The comparison of this consumption with the English steam navy is rather interesting.

| | Weight in English tons. | | Value. | |
|---|---|---|---|---|
| | 1876. | 1877. | 1876. | 1877. |
| Russia | 1,187,020 | 1,044,374 | £698,527 | £564,288 |
| Sweden and Norway | 1,148,617 | 1,195,980 | 639,937 | 622,256 |
| Denmark | 779,822 | 765,818 | 407,353 | 378,670 |
| Germany | 2,278,905 | 2,029,238 | 1,122,666 | 953,772 |
| Holland | 480,891 | 411,655 | 272,863 | 213,715 |
| France | 3,250,564 | 2,982,372 | 1,604,716 | 1,344,006 |
| Spain and the Canaries | 762,569 | 823,871 | 460,841 | 478,468 |
| Italy | 1,213,614 | 1,065,585 | 638,235 | 515,060 |
| Turkey | 290,455 | 214,216 | 162,413 | 113,670 |
| Egypt | 545,337 | 522,170 | 323,852 | 282,710 |
| Brazil | 326,552 | 340,083 | 214,347 | 206,025 |
| Malta | 302,871 | 278,339 | 180,908 | 153,887 |
| British India | 759,855 | 896,174 | 456,763 | 494,350 |
| Other Countries | 2,972,005 | 2,788,953 | 1,718,042 | 1,507,620 |
| Total | 16,299,077 | 15,358,828 | 8,904,463 | £7,828,497 |

Other countries not specially named may be mentioned in the order of their import: West Indies, British North America, Peru, Chili, China, Uruguay, Austria (Trieste and Dalmatia), the Black Sea coast, and also, though in continually decreasing quantities, the United States of America.

## PROSPECTS FOR THE FUTURE.

The position of the coal trade is now everywhere most unfavourable—Great Britain even not excepted. In consequence of the depressed state of trade the great industries—above all the iron industry, which ranks first in the consumption of fuel—require a greatly reduced quantity of coal. To this decreased consumption is added over-production, caused by an output which did not cease increasing until about the middle of May, 1877. It will not be possible to remove the baneful influence of the over-production until either the consumption is again increased by a revival of trade, or until the coalowners reduce their production according to the demand. Necessity has already compelled them to take the latter course. How long it will be before the return of the much-desired increase of consumption, caused by the return of confidence and better trade, we cannot predict. It is, however, certain that this severe crisis will come to an end, and that, with a regular and normal demand, the coal trade will return to its normal and prosperous state.

It is to be expected that the English coal trade will recover from the losses already sustained, or from those which may yet be in store, more quickly than that of most other countries, which have suffered in an equal degree. Exceedingly great facilities for export, abundance of capital, reputation of long standing, and efficient labour, together with a sound commercial policy of the Government, offer the best guarantee for the vigorous development of the English coal trade.

Concerning the distant future, however, certain apprehensions cannot be suppressed. There are, chiefly, two points, the grave importance of which is now recognised even in England.

The most important point is the apprehended *exhaustion of the English coal-fields*, which, although at present far off, has occupied and depressed many minds. GREENWELL, as far back as the year 1846, calculated that the great coalfields of Durham and Northumberland, at an annual rate of production, which has since been doubled, would only last for a further period of 331 years. But EDWARD

HULL, by his estimate of the contents of all English coal districts in the year 1859, arrived at a result which, having regard to the greatly increased output, shows that the English coalmines would be completely exhausted in about 100 years. According to other calculations JEVONS pointed to the year 1965, and ARMSTRONG to the year 2072, as the end of English coalmining. It is not therefore surprising that the English Parliament considered the matter important enough to have it investigated by a committee, and the latter arrived at the opinion that the stock of coal actually known would last till the year 3100.

Whichever of these opinions may be the correct one, the fact remains that at the present time many English coal basins are rapidly approaching exhaustion. Even assuming that the stock of English coal may yet last for centuries, it will be necessary to sink the pits—which already reach a depth of 640 metres—still deeper, and thus their working will become still more troublesome and expensive. Three or four decades may elapse before these facts will affect the English coal trade; but in what degree the higher cost of production will affect the price and sale of coal will entirely depend upon the question whether, and to what extent, the foreign competition has been progressing.

The mention of *foreign competition* brings us to the second point. In all countries in which coalmining is carried on there has been the same increase of production during the last ten years, and in many cases the increase amounted to an even higher percentage of the former output than in Great Britain. This applies principally to Germany and the United States. France and Austria will be fully engaged for years in supplying their home demand; while Holland and the north of France absorb the surplus of the Belgian production. But the German coal is beginning to drive the English coal trade from the German coast, and, after having achieved that, it will entirely depend upon the energy of the coal masters, the co-operation of the transport companies, and the support of the German Government, whether, and how far, the German coal can replace the English on the shores of the Baltic and the German Ocean. From thence the supply of the French and the Mediterranean coast would only be one further and not impossible step in advance.

What has been said of Europe, with regard to the German coal, may be applied to the ports of Central and South America as regards the coal trade of the United States. Considering the probably higher prime cost of the English coal, the expected competition of Germany and America should at least not be underrated. England appears indeed to be already fully alive to these eventualities.

## IRON.*

IN the year 1876 Great Britain produced 6,555,816 English tons of pig-iron—that is 59 per cent, more than half, of the entire production of Europe, and about 47 per cent, or rather less than half, of the production all over the globe. At the beginning of the sixteenth century the production of iron in England was so small that the demand, certainly very inconsiderable, was chiefly supplied by import, mostly from Germany and the country which at present constitutes Belgium. Up to that time the German Hanse towns commanded the seas—at least those of the northern half of Europe. The English import as well as export trade was carried on by them. Thus, for instance, they owned large warehouses in the

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Preussische Zeitschrift für das-Berg-Hütten-und Salinenwesen.
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London "Steelyard," from which England was supplied with foreign manufactures—a picture quite the reverse of to-day's commercial movement.

The rise of the English iron trade began with the year 1717, when blast-furnaces began to use coal and, later on, coke for the production of pig-iron, the Government at the same time imposing import duties on iron, for the protection of the home industry against foreign competition. If that important invention had not been supported by a change of English commercial policy it is very doubtful whether the British iron trade would have attained its present enormous importance, in spite of its favourable conditions for production and export. Owing to the limited demand for iron the development proceeded only slowly during the last century. During the year 1740, 59 furnaces at work in the United Kingdom only produced about 17,000 tons, a quantity which can now be made by a single blast-furnace. In the year 1796 the annual production of pig-iron had risen to 125,000 tons, and the number of blast-furnaces to 130. The number of one million tons was only reached in the year 1835, which was increased in the year 1840 to 1,398,300 tons, with a consumption of 4,940,000 tons of coal. The rapidly-growing demand for iron for the railways—which were being extended at a surprising rate—for engineering, shipbuilding, and every other kind of constructive purposes, and, lastly, the increasing application of iron as a substitute for timber and stone, have since 1840 been the principal causes of the enormous development of the iron trade. The rich ore and coalmines of the country, abundance of capital, excellent skilled labour, which had been continually improving from generation to generation for more than a century, and its long-acquired reputation for efficiency, extraordinarily favourable conditions of transport, the monopoly of supplying the vast colonies of the empire, the prestige of the British commercial flag, and lastly, English policy, which never fails to consider material interests, are further resources never offered to any other people in the same degree and the same combination.

Although in the beginning of the present century English industry had already acquired sufficient strength to compete without danger with other countries, the English Government was prudent enough to allow the rising industry to reach its full strength before withdrawing the protective duties. In the year 1718 the duty on pig and bar iron was 2s. per cwt.; in 1782, 2s. 9d.; in 1797, 3s. 2d.; in 1802, 3s. 9d.; in 1825, even 6s. 6d.; and if imported by foreign vessels, 7s. 6d. From that time the duty on iron has been continually diminished; but not until the home industry was fully able to supply the home demand, and when it was moreover perfectly certain that foreign competition could not inflict the least damage on English industry. The last trace of the iron duties disappeared only at the conclusion of the commercial treaty with France in the year 1862.

Now the English iron trade dictates the prices of iron and steelware in all free-trading countries of the world; and even where protection still exists, the market price is regulated by the English quotations. By her great advantages as regards production, as well as by her excellent means of transport, Great Britain is at present placed beyond the reach of serious competition. By an enormous production of coal and iron the powerful insular state has rendered its commanding position in the international trade nearly unassailable, but whether for ever so is to be doubted.

## IRON ORES.

The supremacy of the English iron trade is based, in the first place, on the great abundance of excellent ores, which, moreover, are mostly found in close proximity to, or at least not beyond a moderate distance from, coalmines and calcareous flux. As regards the quantity of production the well-known

*Cleveland ore*, in Yorkshire, ranks first; after this the *clay ironstone* and *blackband* in Scotland, Staffordshire, Yorkshire, Wales, and Shropshire; *brown iron ore* in Devonshire, Gloucestershire, Wiltshire, Northamptonshire, and Shropshire; *hematite* in Lancashire, and in the Isle of Man; spathic ore in Northumberland, Durham, and Somersetshire. The names of most of these counties are already found in our description of the coal trade. Thus by a happy chance most of the districts which are rich in iron possess also the mineral fuel necessary for its utilisation. The quality of the ores is in England, like everywhere, of a great variety, and in some cases varying even in the same pit. WEDDING, in his well-known treatise on iron-making, gives a great number of analyses of English iron ores, and the work entitled, "The Iron Ores of Great Britain," published at the expense of the English Government, is even more complete in this respect. Confining ourselves to the total quantity of iron contained in the ores, as compared with the proportion of manganese, which has a considerable influence on the quality of iron, and also to phosphorus and sulphur, as elements which are detrimental to the quality of pig-iron, we find on the average :—

| | Iron. | Protoxide of Manganese. | Phosphoric Acid. | Sulphuret of Iron. |
|---|---|---|---|---|
| | % | % | % | % |
| In Magnetic Ironstone... | 57·0 to 68·0 | 0·14 to 1·88 | 0·01 to 0·70 | 0·07 to 0·08 |
| „ Hematite..... | 47·50 „ 66·0 | 0·01 „ 1·13 | Traces „ 1·02 | 0·03 „ 0·06 |
| „ Brown Iron Ore..... | 11·98 „ 63·04 | 0·0 „ 1·60 | 0·0 „ 3·17 | 0·02 „ 0·17 |
| „ Spathic Iron Ore ... | 13·98 „ 49·78 | 1·93 „ 12·64 | Traces „ 0·22 | 0·03 „ 0·11 |
| „ Spathose Iron Ore ... | 24·0 „ 43·0 | 0·90 „ 3·30 | Traces „ 1·40 | 0·05 „ 0·21 |
| „ Clay Ironstone ..... | 17·34 „ 49·17 | 10·0 „ 1·30 | 0·0 „ 5·05 | 0·05 „ 1·60 |

As a matter of course these condensed data can only give an approximately correct idea of the quality of English ores. Generally speaking they may be termed fairly rich ores on account of their high average percentage of iron. The presence of phosphorus, which for some sorts of iron—for instance, foundry pig—is less injurious, although not desirable, makes iron unfit for the Bessemer process, unless in very small quantities. Sulphur, too, is a very disagreeable, but unfortunately often intrusive, companion of iron.

Great Britain is amply provided with first-class ores, as well as with such of an inferior description, which, however, can be easily worked. This country is therefore able to produce an inferior but exceedingly cheap iron, and also the better sorts, in greater quantities than many other countries. Ores specially adapted for the manufacture of Bessemer steel are not wanting, although this does not prevent the import of ores of excellent quality, particularly free from phosphorus, which are brought from Elba, Algiers, Spain, and recently even from North America.

The total output of iron ores since the year 1860 is given in the following table :—

| | Eng. Tons. | Value in £. | | Eng. Tons. | Value in £. |
|---|---|---|---|---|---|
| 1860 ..... | 8,023,863 | 2,466,929 | 1871 ..... | 16,334,192 | 7,670,572 |
| 1866 ..... | 9,664,600 | 3,119,098 | 1872 ..... | 16,584,150 | 7,774,874 |
| 1867 ..... | 10,020,631 | 3,210,098 | 1873 ..... | 15,576,835 | 7,573,676 |
| 1868 ..... | 10,168,797 | 3,196,600 | 1874 ..... | 14,844,303 | 7,318,169 |
| 1869 ..... | 11,508,034 | 3,732,560 | 1875 ..... | 15,820,385 | 5,975,410 |
| 1870 ..... | 14,370,041 | 4,951,220 | 1876 ..... | 16,840,865 | 6,825,705 |

According to the above, the production rose, as regards the weight, from 1860-70, 179% ; and from 1860-76, 209·9%.

The import and export of iron ores amounted to—

| | Import. | | Export. | |
|---|---|---|---|---|
| | Eng. Tons. | Value in £ sterling. | Eng. Tons. | Value in £ sterling. |
| During the year 1860..... | 23,112 | 15,155 | 125 | 179 |
| „ 1866..... | 56,689 | 49,081 | 350 | 892 |
| „ 1867..... | 86,569 | 69,218 | 359 | 538 |
| „ 1868..... | 114,435 | 94,620 | 329 | 455 |
| „ 1869..... | 131,321 | 101,644 | 661 | 1,299 |
| „ 1870..... | 208,310 | 166,190 | 905 | 1,296 |
| „ 1871..... | 324,034 | 343,175 | 256 | 308 |
| „ 1872..... | 801,503 | 1,014,842 | 1,124 | 3,492 |
| „ 1873..... | 967,536 | 1,278,278 | 1,693 | 2,305 |
| „ 1874 ..... | 754,141 | 1,021,481 | 1,092 | 1,501 |
| „ 1875.. ..... | 458,673 | 583,571 | 2,458 | 2,954 |
| „ 1876..... | 675,190 | 798,205 | 642 | 906 |
| „ 1877..... | 1,140,434 | 1,239,904 | (?) | (?) |

Since the year 1860 the imports have therefore increased from 23,112 to 1,140,434 tons, which quantity will consist chiefly, if not exclusively, of Bessemer ores. This insignificant ore export proves that England prefers to send out her natural products in the shape of manufactured goods, at prices increased by labour and interest on capital, instead of selling them as raw materials.

The apprehension of an impending exhaustion of the English coalmines has also been extended to the iron-mines. Although an annual production of 17 million of tons may already have exhausted many a mine, the still existing abundance scarcely leaves room for such an apprehension. Whether this will also be the case in regard to the quality of the ores—in other words, whether the ores to be found at greater depth, or in entirely new deposits, will yield iron of the same quality—has hitherto not been sufficiently investigated.

The quantity of iron ores which have been consumed, including the import, was—

| | Production. Eng. Tons. | Value in £ sterling. | Import. Eng. Tons. | Total consumption Tons. |
|---|---|---|---|---|
| During the year 1869... | 11,508,034 | 3,732,560 | 131,297 | 11,639,331 |
| „ 1872... | 16,584,150 | 7,714,874 | 800,091 | 17,384,241 |
| „ 1876... | 16,840,865 | 6,825,704 | 675,161 | 17,516,027 |

Accordingly the consumption of iron ores rose 149·8% from 1869 to 1872 ; and 150·8% during the years 1869 to 1876.

## PIG-IRON.

English blast furnaces use on a general average, according to quality, from 2·4 to 2·8 (in exceptional cases over 3) tons of iron ore, from 2¾ to 3¼ tons of coal or coke, and ¾ to 1¼ ton of calcareous flux, for the production of a ton of pig-iron. Although the sources of these three materials are rarely far from one another, the slight surplus of the weight of coal compared with the ore has become more and

The export figures include the shipments from the Tees, Tyne, Wear, and the Hartlepools.

In Scotland there were at the beginning of 1877 119 furnaces in blast, of which, however, 33 have been blown out before the end of the year; so that the year 1878 was begun with only 86 furnaces in blast. According to the comparative statistics of COLVIN the production of the Scotch iron trade since 1873 amounted to the following figures in English tons :—

| | 1873. | 1874. | 1875. | 1876. | 1877. |
|---|---|---|---|---|---|
| Annual production | 933,000 | 806,000 | 1,050,000 | 1,103,000 | 982,000 |
| Shipped to foreign ports | 398,850 | 296,803 | 368,453 | 303,572 | 274,400 |
| „ coastwise | 214,061 | 166,104 | 174,056 | 166,190 | 170,000 |
| Total shipped | 612,911 | 462,907 | 542,509 | 469,942 | 444,400 |
| Consumed in Scotland | 373,000 | 317,000 | 360,000 | 370,000 | 335,000 |
| Stock on December 31 | 120,000 | 96,000 | 170,000 | 363,000 | 505,000 |
| Average number of furnaces in blast | 119 | 96 | 117 | 116 | 103 |
| Furnaces in blast, Dec. 31 | 122 | 121 | 113 | 116 | 88 |
| Average price during year | 117·3s. | 87·6s. | 65·9s. | 58·6s. | 54·6s. |
| Price, Dec. 31 | 117·6s. | 76s. | 64·6s. | 58s. | 51·6s. |
| Production of wrought-iron | 189,310 | 180,000 | 196,000 | 230,000 | 218,000 |
| Import of English pig-iron | 125,000 | 200,000 | 220,000 | 285,000 | 353,000 |

The production and shipments of Scotch pig-iron are, according to this table, smaller in the year 1877 than in the years 1875 and 1876, which, in the first instance, is accounted for by the decrease in the foreign demand; and, secondly, by the competition of Middlesbrough.

The total production of pig-iron in Great Britain is stated to be :—

| | Eng. Tons. | Value. £ Sterling. | Furnaces in blast. |
|---|---|---|---|
| During the year 1860 | 3,826,589 | 9,566,880 | 582 |
| „ 1866 | 4,563,704 | 11,309,742 | 618 |
| „ 1867 | 4,760,820 | 11,902,557 | 551 |
| „ 1868 | 4,969,994 | 12,381,280 | 560 |
| „ 1869 | 5,445,525 | 13,614,397 | 600 |
| „ 1870 | 5,962,180 | 14,908,787 | 664 |
| „ 1871 | 6,626,896 | 16,667,947 | 673 |
| „ 1872 | 6,741,642 | 18,540,304 | 702 |
| „ 1873 | 6,566,171 | 18,057,739 | 683 |
| „ 1874 | 5,991,152 | 16,476,372 | 649 |
| „ 1875 | 6,365,200 | 15,645,774 | 629 |
| „ 1876 | 6,505,575 | 16,062,192 | 585 |

PERCENTAGE OF INCREASE IN PRODUCTION AND VALUE.

| | Production. | Value. |
|---|---|---|
| From 1860—1870 | 155·8 % | 155·2 % |
| From 1870—1876 | 109·9 „ | 107·7 „ |
| From 1860—1876 | 171·5 „ | 168·0 „ |

The greatest quantity of pig-iron was produced during 1872—a year of unusual activity in the trade of all civilised countries—when there was a very strong demand and a rapid increase in the prices of iron, owing chiefly to the extension of railways, but also to the brisk state of the engineering and ship-building trades, and to the increasing application of iron for ordinary building purposes.

Within a year the quotations for ordinary brands were more than doubled, and a general rise of prices set in, extending from the iron trade to all other branches of industry, and causing a great change of prices in nearly all manufactured articles. But the reaction was likewise experienced first in the iron trade. In the year 1873 the quotations for iron were still high indeed, but the prices of coal, ore, and limestone, the rate of wages, and cost of carriage, had already taken part in the rise to such a degree that even the higher quotations for iron and ironware of all descriptions left only a moderate profit to the makers. Meanwhile the ironworks of other countries had also increased their production, and when, owing to well-known events, commercial confidence suddenly disappeared, and the demand fell off, it turned out that far more iron was being produced than was needed. Whether the fault may be attributed more to the increased production or to the diminished consumption, the fact that the iron trade of all countries is suffering from international over-production cannot be disputed; and here it is again doubtful which countries have had the largest share in the latter.

As England alone satisfies nearly one-half of the entire demand for pig-iron all over the world, foreigners are only too easily inclined to give the English iron trade all the blame; and this reproach is indeed not without foundation, considering that England has again increased the production of pig-iron from 1874 to 1876 by the considerable quantity of 573,623 tons, in spite of the falling prices and diminished demand. As already stated, even in the year 1877 Cleveland produced more iron than in 1876, while the Scotch ironworks, with a better appreciation of circumstances, have realised the fact that in order to bring back a normal state of trade it is necessary above all things to adjust the supply according to the demand.

As for the prices, we select the quotations for Scotch pig-iron, this being an article well known and much sought after in foreign countries as well as in England, especially as Scotch warrants usually determine in a certain degree the prices of the other descriptions of iron.

Scotch warrants were quoted at the following average prices per ton :—

| | | £ | s. | d. | | | £ | s. | d. |
|---|---|---|---|---|---|---|---|---|---|
| During | 1845..... | 3 | 16 | 0 | During | 1862..... | 2 | 13 | 0 |
| „ | 1846..... | 3 | 11 | 8 | „ | 1863..... | 2 | 15 | 9 |
| „ | 1847..... | 3 | 5 | 0 | „ | 1864..... | 2 | 17 | 3 |
| „ | 1848..... | 2 | 4 | 4 | „ | 1865..... | 2 | 14 | 9 |
| „ | 1849..... | 2 | 5 | 8 | „ | 1866..... | 3 | 0 | 6 |
| „ | 1850..... | 2 | 4 | 2 | „ | 1867..... | 2 | 13 | 6 |
| „ | 1851..... | 1 | 19 | 9 | „ | 1868..... | 2 | 12 | 9 |
| „ | 1852..... | 2 | 5 | 1 | „ | 1869..... | 2 | 13 | 3 |
| „ | 1853..... | 3 | 2 | 3 | „ | 1870..... | 2 | 14 | 4 |
| „ | 1854..... | 3 | 19 | 8 | „ | 1871..... | 2 | 18 | 11 |
| „ | 1855..... | 3 | 10 | 9 | „ | 1872..... | 5 | 1 | 10 |
| „ | 1856..... | 3 | 12 | 6 | „ | 1873..... | 5 | 16 | 11 |
| „ | 1857..... | 3 | 9 | 2 | „ | 1874..... | 4 | 7 | 6 |
| „ | 1858..... | 2 | 14 | 4 | „ | 1875..... | 3 | 5 | 9 |
| „ | 1859..... | 2 | 11 | 9 | „ | 1876..... | 2 | 18 | 5½ |
| „ | 1860..... | 2 | 13 | 6 | „ | 1877..... | 2 | 14 | 4 |
| „ | 1861..... | 2 | 9 | 3 | | | | | |

The English iron trade is equally well situated for export. The advantage of an easy and cheap conveyance to seaports in consequence of numerous railroads and canals, the lowest rates of freight at sea, the possibility of finding within the shortest time ships to sail to almost every seaport of the world, and the facilities for selling to the vast English colonies, are powerful factors, which would secure to English iron the most extensive export, even if this commodity could not be supplied at the cheapest possible rates. England, in fact, supplies the world with iron and iron and steel wares in the same degree as with her coal.

Great Britain exported during the last years on an average one-sixth to one-seventh of its entire production of pig-iron (in 1876 15·2 per cent). The import and export of pig-iron in the years 1860-1877 amounted to :—

| | Import. | | Export. | |
|---|---|---|---|---|
| | Eng. Tons. | Value in £ Sterling. | Eng. Tons. | Value in £ Sterling. |
| During the year 1860 ..... | 11,846 | 80,246 | 342,566 | 974,065 |
| „ 1866 ..... | 17,067 | 96,479 | 500,500 | 1,542,145 |
| „ 1867 ..... | 25,030 | 135,404 | 565,612 | 1,645,788 |
| „ 1868 ..... | 24,652 | 109,703 | 552,999 | 1,582,391 |
| „ 1869 ..... | 22,441 | 93,592 | 710,656 | 2,055,073 |
| „ 1870 ..... | 39,726 | 178,650 | 753,339 | 2,229,045 |
| „ 1871 ..... | 55,637 | 299,206 | 1,057,458 | 3,229,408 |
| „ 1872 ..... | 100,561 | 689,134 | 1,331,143 | 6,712,579 |
| „ 1873 ..... | 74,770 | 601,136 | 1,142,065 | 7,118,037 |
| „ 1874 ..... | 56,939 | 416,198 | 776,116 | 3,673,734 |
| „ 1875 ..... | 47,605 | 342,061 | 947,827 | 3,449,916 |
| „ 1876 ..... | 31,449 | 219,223 | 910,005 | 2,842,434 |
| „ 1877 ..... | ? | ? | 881,442 | 2,524,857 |

The percentage of export has increased :—

| | According to Weight. | | According to Value. |
|---|---|---|---|
| From 1860 to 1870 ..... | 219·5 % | ..... | 228·8 % |
| From 1870 „ 1877 ..... | 117·3 „ | ..... | 113·6 „ |
| From 1860 „ 1877 ..... | 258·8 „ | ..... | 259·8 „ |

Of the 881,442 tons exported in the year 1877, 234,261 went direct to Germany, 198,999 tons to Holland, 98,825 tons to Belgium (the greatest part of the iron shipped to Belgium and Dutch ports finds its way to Germany), 107,400 tons to France, 35,904 to the United States of America, 21,235 tons to British North America, and 184,818 tons to other countries.

## STEEL.

In Steel-making a complete change has been experienced in consequence of Bessemer's well-known invention ; the other sorts, although still in demand, having to a great extent been superseded by the enormous production of Bessemer steel. Great Britain took advantage of this invention at once, especially as the hematite ores—a quality eminently suitable to the process, on account of being free from phosphorus—are found and cheaply raised within the country itself, principally in West Cumberland, where a great number of furnaces are producing Bessemer pig-iron. Besides this, the steel works, being

mostly situated on the coast, can import excellent Bessemer ores at a very moderate cost from Elba, Spain, Algiers, and recently even from North America, as ballast in returning coal ships.

In the year 1869 there existed only 59 Bessemer converters, in 18 works; but in the year 1872 the number of works had increased to 19, and the number of converters to 91. In the spring of 1877 the number of converters had risen to 110. Of these as many as 18 belong to the Barrow Hematite Steel Company, and 10 to the Mersey Steel and Iron Works, in Liverpool.

Of the amount of production we have no reliable information. In 1877 the production of Bessemer steel in Great Britain was estimated at about 750,500 tons, and of steel of all kinds at about 891,500 tons, whereas in 1875 the latter is stated to have been about 712,500 tons.

The import and export of steel was :—

| | Import. | | Export. | |
|---|---|---|---|---|
| | Eng. Tons. | Value in £ sterling. | Eng. Tons. | Value in £ sterling. |
| During the year 1820... | ... | ... | 438 | 19,809 |
| „ 1830... | ... | ... | 832 | ... |
| „ 1840... | 768 | ... | 2,583 | ... |
| „ 1850... | 49 | ... | 10,593 | ... |
| „ 1860... | 3,788 | 75,330 | 32,173 | 986,228 |
| „ 1866... | 4,451 | 67,246 | 34,413 | 1,124,917 |
| „ 1867... | 8,636 | 128,860 | 32,685 | 1,065,614 |
| „ 1868... | 7,654 | 114,110 | 31,362 | 1,009,342 |
| „ 1869... | 10,768 | 160,655 | 33,560 | 1,040,707 |
| „ 1870... | 8,070 | 113,368 | 34,962 | 1,103,936 |
| „ 1871... | 7,610 | 85,162 | 39,189 | 1,198,428 |
| „ 1872... | 7,545 | 110,545 | 44,969 | 1,478,737 |
| „ 1873... | 9,525 | 147,740 | 39,418 | 1,462,857 |
| „ 1874... | 7,384 | 128,380 | 31,440 | 1,203,719 |
| „ 1875... | 7,509 | 119,224 | 29,858 | 1,073,733 |
| „ 1876... | 9,264 | 138,667 | 25,777 | 878,412 |
| „ 1877... | 5,020 | 70,723 | 24,402 | 808,149 |

As regards weight, the percentage of export was (taking the initial amount of every period as 100) :—

| | |
|---|---|
| From 1840 to 1860 | 1245·6 % |
| From 1860 to 1870 | 108·7 |
| From 1870 to 1877 | 69·9 |
| From 1840 to 1877 | 945·7 |

Of the 24,402 tons of steel exported in the year 1877, 2,855 tons went to France, 6,282 tons to North America, and 15,265 tons to other countries.

## BAR-IRON, RAILS, AND SHEET-IRON.

The number of rolling mills at work was :—

| | | | | | | |
|---|---|---|---|---|---|---|
| In 1869, | 245 | works, with | 6,243 | puddling furnaces and | 859 | roll trains. |
| In 1872, | 276 | „ | 7,311 | „ „ | 1,015 | „ |
| In 1873, | 285 | „ | 7,264 | „ „ | 939 | „ |
| In 1875, | 314 | „ | 7,575 | „ „ | 909 | „ |
| In 1876, | 312 | „ | 7,259 | „ „ | 942 | „ |

In 1876 these works were divided amongst the various districts as follows :—

| | Works. | Puddling Furnaces. | Roll Trains. |
|---|---|---|---|
| Northumberland and Durham..... | 28 | 1,347 | 80 |
| Yorkshire and Cleveland, Leeds, Bradford, Sheffield, and Rotherham ..... | 45 | 1,365 | 168 |
| Derbyshire ... ..... | 5 | 69 | 14 |
| Lancashire ..... ..... | 26 | 421 | 78 |
| Cumberland ..... | 5 | 80 | 11 |
| Shropshire ..... | 9 | 175 | 24 |
| North Staffordshire ..... ..... | 9 | 433 | 39 |
| South Staffordshire ..... ... | 129 | 2,009 | 342 |
| Gloucestershire ..... | 1 | 8 | 2 |
| Somersetshire..... | 1 | 22 | 2 |
| Wales ..... | 36 | 1,024 | 131 |
| Scotland ..... | 18 | 311 | 50 |
| Total ..... .. | 312 | 7,259 | 942 |

On this important branch of the iron trade we have no official information. According to estimates based on the consumption of coal (a very uncertain basis) the entire production of all descriptions of wrought iron (including 984,702 tons of rails) has been 2,273,525 tons in the year 1870, and 2,386,719 tons (including 1,170,226 tons of rails) in the year 1874. We reproduce these figures for want of more exact statements, although their accuracy is very doubtful.

The statistics of import and export are far more reliable—at least in so far as the weight of materials shipped is concerned. But here the valuations must be considered with greater caution ; for it appears that the same object—for example, rails—has been valued very differently according to the various countries to which it has been exported, and that the difference of prices amounts to a high percentage.

The quantities of bar, angle, bolt, and rod iron, exclusive of rails, were :—

| | Import. | | Export. | |
|---|---|---|---|---|
| | Eng. Tons. | Value in £ sterling. | Eng. Tons. | Value in £ sterling. |
| During the year 1820.. | 9,869 | ? | 54,406 | 532,698 |
| „ 1830.. | 14,947 | ? | 67,927 | ? |
| „ 1840.. | 18,949 | ? | 144,719 | 1,142,895 |
| „ 1850.. | 34,066 | ? | 469,434 | 2,801,043 |
| „ 1860.. | 54,061 | 659,620 | 311,459 | 2,385,871 |
| „ 1866.. | 64,178 | 668,932 | 269,419 | 2,328,695 |
| „ 1867.. | 71,703 | 732,875 | 301,428 | 2,344,549 |
| „ 1868.. | 64,689 | 600,673 | 302,624 | 2,285,187 |
| „ 1869.. | 68,463 | 622,511 | 358,865 | 2,698,696 |
| „ 1870.. | 74,149 | 667,345 | 321,455 | 2,615,245 |
| „ 1871.. | 74,329 | 707,613 | 349,084 | 2,921,777 |
| „ 1872.. | 82,371 | 921,567 | 313,600 | 3,632,818 |
| „ 1873.. | 74,666 | 988,885 | 286,845 | 3,755,980 |
| „ 1874.. | 73,469 | 1,058,390 | 258,953 | 3,054,547 |
| „ 1875.. | 89,822 | 1,320,059 | 276,068 | 2,725,907 |
| „ 1876.. | 85,197 | 1,094,064 | 227,945 | 1,945,445 |
| „ 1877.. | 92,018 | 979,857 | 247,733 | 1,924,734 |

The increase of export and import of wrought iron came up to the following percentage (taking the initial amount of every period as 100) :—

| | Import according to | | Export according to | |
|---|---|---|---|---|
| | Weight. | Value. | Weight. | Value. |
| | % | % | % | % |
| From 1820 to 1860 ... | 547·7 | ? | 572·0 | 448·3 |
| From 1860 to 1870 ... | 137·2 | 101·2 | 103·2 | 119·6 |
| From 1870 to 1877 ... | 124·3 | 147·0 | 77·1 | 73·6 |
| From 1820 to 1877 ... | 938·8 | ? | 455·3 | 361·7 |

Of the 247,733 tons of wrought iron exported in the year 1877 there went 30,131 tons to British North America, 51,066 tons to India, 29,746 tons to Australia, 4,079 tons to Russia, 5,540 tons to Germany, 277 tons to France, 22,914 tons to Italy, 7,097 tons to Turkey, 5,879 tons to the United States, 4,290 tons to Holland (or to Germany), and the remaining 86,714 tons to other countries.

As regards rails, Great Britain has met with competition in nearly all the iron-producing countries during the last years, perceptible chiefly since 1870 by a steady decrease in export of this article. There has never been an importation of foreign rails into England. The export of rails, iron as well as steel, amounted to the following figures :—

| | Eng. Tons. | Value in £ sterling. |
|---|---|---|
| During the year 1860 | 453,445 | 3,408,759 |
| „ 1866 | 498,021 | 4,183,198 |
| „ 1867 | 580,571 | 4,861,129 |
| „ 1868 | 583,488 | 4,660,612 |
| „ 1869 | 888,010 | 7,238,170 |
| „ 1870 | 1,059,392 | 8,756,552 |
| „ 1871 | 981,197 | 8,084,619 |
| „ 1872 | 945,420 | 10,225,492 |
| „ 1873 | 785,014 | 10,418,852 |
| „ 1874 | 782,665 | 9,638,236 |
| „ 1875 | 545,981 | 5,453,836 |
| „ 1876 | 414,656 | 3,700,105 |
| „ 1877 | 497,924 | 3,864,916 |

The percentage of increase or decrease has been (initial amount of period = 100) :—

| | According to Weight. | According to Value. |
|---|---|---|
| From 1860 to 1870 | 238·8 % | 256·0 % |
| From 1870 to 1877 | 47·0 „ | 44·1 „ |
| From 1860 to 1877 | 109·7 „ | 113·3 „ |

How much of the 497,924 tons of rails exported in 1877 was steel and how much iron has not been ascertained. It is, however, very probable that by far the

greater portion was steel. Among the larger items may be mentioned 84,554 tons to Russia, 60,481 tons to Sweden and Norway, 23,396 tons to Germany, 21,605 tons to Spain, 8,938 tons to Italy, 2,524 tons to the United States, 24,263 tons to the Brazils, 1,308 tons to Peru, 36,378 tons to British North America, 106,049 tons to the East Indies, 84,783 tons to Australia, and 155 tons and 123 tons to France and Belgium respectively.

The manufacture of hoop-iron, tires, plates, and sheets, is also carried on in a very extensive way. The quantities exported were :—

| | Hoops, Tires, Plates, Sheets. | | Tinplate. | |
|---|---|---|---|---|
| | Eng. Tons. | Value in £ sterling. | Eng. Tons. | Value in £ sterling. |
| During the year 1860 | 108,503 | 1,116,568 | 60,032 | 1,500,812 |
| „ 1866 | 135,657 | 1,784,226 | 70,979 | 1,896,192 |
| „ 1867 | 146,188 | 1,817,228 | 78,906 | 2,060,410 |
| „ 1868 | 150,231 | 1,809,320 | 88,406 | 2,092,868 |
| „ 1869 | 198,548 | 2,337,154 | 96,702 | 2,304,820 |
| „ 1870 | 181,484 | 2,119,629 | 99,851 | 2,362,872 |
| „ 1871 | 200,337 | 2,399,203 | 119,606 | 2,900,625 |
| „ 1872 | 207,495 | 3,414,906 | 118,083 | 3,806,973 |
| „ 1873 | 201,570 | 3,722,889 | 120,638 | 3,953,042 |
| „ 1874 | 168,430 | 2,975,409 | 122,960 | 3,714,810 |
| „ 1875 | 204,483 | 3,304,148 | 138,363 | 3,686,607 |
| „ 1876 | 191,982 | 2,853,621 | 132,564 | 2,891,693 |
| „ 1877 | 199,863 | 2,725,597 | 153,108 | 3,034,917 |

The percentage in the rise of export was :—

| | According to | | According to | |
|---|---|---|---|---|
| | Weight. | Value. | Weight. | Value. |
| From 1860 to 1870 | 167·9 % | 189·9 % | 166·3 % | 157·3 % |
| From 1870 to 1877 | 110·6 „ | 129·0 „ | 153·1 „ | 128·4 „ |
| From 1860 to 1877 | 185·0 „ | 244·2 „ | 255·0 „ | 202·3 „ |

The production of tinplate happens to be known. There existed in 1872 sixty-one establishments in which tinplate was being manufactured. Thirty-two of these works return their production as 1,534,181 boxes, of a weight of 78,084 tons. The total production of all works was estimated at 2,977,851 boxes, which, according to the same calculation, should weigh 151,563 tons. For 1876 the production is stated as 2,816,393 boxes (149,569 tons).

Of iron and steel wire, in which articles Rhenish Westfalia is an important competitor with England in consequence of the excellent quality it produces rather than of the quantities brought into the market, the export, in 1876, was 44,613 tons, of the value of £731,148 ; and in 1877, 50,503 tons, having a value of £744,906. Telegraph wire, for which there is a great demand, is not included in the above.

The extent to which the prices of the articles previously enumerated have lately declined is apparent from the following table. Prices quoted per ton were :—

| | Merchant Iron. | Iron Rails. | Steel Rails. | Boiler Plate. | Rolled Wire. |
|---|---|---|---|---|---|
| | Shillings. | Shillings. | Shillings. | Shillings. | Shillings. |
| 1st July, 1871 | 165 | 185 | 291 | 220 | 251 |
| 1st „ 1872 | 248 | 268 | 370 | 332 | 346 |
| 1st „ 1873 | 255 | 257 | 351 | 408 | 334 |
| 1st „ 1874 | 171 | 170 | 242 | 239 | 258 |
| 1st „ 1875 | 153 | 155 | 203 | 207 | 174 |
| 1st „ 1876 | 140 | 135 | 148 | 168 | 160 |
| 1st „ 1877 | 128 | 128 | 138 | 160 | 142 |

In order to give even an approximately correct picture of the English iron trade, it is necessary to refer to the productions of the foundries and the manufacture of ordinary as well as the finer articles of iron—from the heavy ship anchor and the cable chain to the needle and the watch spring; from the construction of iron bridges to the finest art castings; from the colossal cast-steel cannon to the pocket-knife; from the construction of iron railway stations to the production of the steel pen; in short, to the hundreds and thousands of larger and smaller, and more or less costly articles, some of which are little sought after and others of large demand and daily consumption. It is to be regretted that for these all statistical data are wanting, and calculations based on probabilities give results too unreliable. Some little information from the export returns—for these articles also show enormous figures in weight and value—prove that these branches, too, have been developed on a grand scale. The export amounted to :—

| | 1876. | | 1877. | |
|---|---|---|---|---|
| | English Tons. | Value in £ sterling. | English Tons. | Value in £ sterling. |
| Castings and ordinary ironware ... | 244,054 | 4,041,418 | 254,813 | 3,640,715 |
| Fine iron and steel manufactures.. | 25,777 | 878,412 | 24,402 | 808,149 |
| Totals ..... | 269,831 | 4,919,830 | 279,215 | 4,448,864 |

If, finally, all export items of pig, steel, rolled iron, and the finer manufactures of iron, are summed up, the colossal total weight of 2½ million tons exported is reached, equivalent to a value of over 20 million pounds sterling. The English iron industry exported iron and manufactured iron and steel wares of all descriptions in 1876 to the amount of 2,224,470 tons, and of £20,737,410 value; in 1877, 2,344,651 tons, of £20,094,562 value.

Of her production of pig-iron, amounting to 6¾ million of tons, Great Britain thus only sends abroad, in unaltered state, on an average, one-seventh (900,000 tons), at a selling price of from 2½ to 2¾ millions sterling; the balance of 5·7 million tons remains at home to be converted into partly or wholly manufactured articles. After satisfying the home demand Great Britain sends another 1,400,000 tons of iron and steel manufactures away, the value of which, however, is now enhanced by the amount of interest on capital outlay and wages expended upon it, and reaches £18,000,000. Hence the price of pig-iron may be taken at £2 15s. per ton, and that of the manufactured articles at £13 per ton. Supposing that a ton of pig-iron could be converted into a ton of manufactured articles, the English iron trade would have raised its value 4¾ times by the labour expended upon it. Taking, however, even a high average loss upon the weight which the

raw material suffers in being converted into finished articles, its enhanced value may still be taken as being threefold that of pig-iron.

In the absence of statistical data we are compelled to desist from following up the further manipulation of the steel, of different kinds of bar-iron and forgings, of plates and sheets, hoops and tires, of castings, &c., in the manufacture of locomotives and prime movers, in the production of steam boilers, in the construction of ships, and in the application to machines of all descriptions, and to forego naming the various branches which are comprised under the collective name of machine-making, and are so nearly related to the iron trade that they are often without further consideration set down to form part of the latter. Some of these branches—among others that of iron ship-building, many specialities in the production of steam engines and labour-saving machines for the most manifold branches of trade, as machines for spinning, weaving, knitting, embroidery, and not less for the manufacture of paper, for manipulating leather, wood, stone, &c.—have obtained for themselves a world-wide reputation, and, what at the present time is perhaps still more, they have maintained it. The same great feature that may be traced through the whole British industry cannot but be recognised even here; and the advantages which English industry enjoys are in a large measure beneficial to the machine trade too. Without disparaging, however, its significance it must be acknowledged that the English machine trade—some specialities excepted—does not in the same measure surpass in the extent of its productiveness the same branches in other competing countries, as is the case in the manufacture of iron.

## CONDITION OF THE WORKING CLASSES.

What has been said before of the English collier in general holds good also when the ironworker comes under consideration. Physically competent in a high degree, accustomed from early youth to endure the high temperatures and the intense radiation of heat given off by white-hot or molten iron and steel, and yet ready to exert at the given moment the full power of his frame in moving the heaviest weights—gifted with a practical eye which discriminates at a glance how a given piece of work may be done according to order, but in the most easy and convenient manner—such are the valuable qualities of the English ironworker, in whom the ideal of physical labour is almost realised. Though often without the desirable elementary education, his intellect is sharpened by experience and care, and thus he trains and fits himself with the most painstaking accuracy for the various operations of his trade. In Germany, in America, Belgium, Austria, and France, the efficiency of the ironworkers has made considerable progress, but they are yet far from standing on a level with the English. But notwithstanding this testimony of the individual and objective efficiency of the English ironworker, we are bound to state here that the intercourse between employer and employed has of late years become extremely difficult; the exertions to obtain higher wages and to reduce at the same time the working hours, have taken larger dimensions, and strikes are more readily resorted to than ever. While formerly, in the years 1860-1870, the strikes emanated chiefly from the textile industries as a centre of agitation, the ironworker has assumed the lead in the offensive movement since 1871, and by his incessant demands for higher wages encouraged other trades—the collier and the building artificer—to follow his example. Even during the year 1877, the worst imaginable in the iron trade as regards profits, of the 191 strikes that occurred in the United Kingdom, no less than 23 fell to the share of the iron trade alone. Some of these lasted for months, until the workmen were finally obliged to submit to the terms insisted on by the masters.

As regards the rates of wages in the iron trade, they stand at a higher figure in England than in other countries; but when the increased quantity and quality

of the labour which is obtained for it is taken into consideration they are about equalling those of foreign iron districts.

Statements of the amount of daily or weekly wages paid at particular works are not wanting, but these differ so considerably from each other, even for neighbouring districts, that they deserve but little credit.

The following average rates have been obtained from a North of England manager, but it is added that these figures can only be taken as approximately correct. According to him the average daily earnings of an ironworker amounted to :—

| | 1869. | 1873. | 1876. |
|---|---|---|---|
| In Scotland | 3/3 to 6/6 | 4/6 to 6/6 & 7/10 | 3/6 to 5/10 |
| In Staffordshire | 3/9 „ 6/10 | 4/2 „ 7/6 „ 8/6 | 3/10 „ 6/2 |
| In Wales | 2/10 „ 5/9 | 3/10 „ 5/9 „ 7/6 | 3/- „ 5/6 |

This statement goes to prove, and it is corroborated from other parts, that the rate of wages, which rose rapidly in 1872 and 1873, has returned to its original level, with this somewhat strange difference, that now a little less is paid for high-class skilled labour, whereas for the unskilled labour the rate is slightly higher than in the year 1869.

As to the number of hands employed, statistical information which would afford anything like a safe basis is absolutely wanting. Judging by the figures of the existing number of blast-furnaces, steelworks, rolling-mills, foundries, &c., the number of workmen may be safely estimated at 600,000. If, however, what may be called the smaller industries, such as ship-building and machine-making, are included, the figure may be taken at one million, and is probably too low an estimate.

## PROSPECTS OF THE FUTURE.

In Great Britain, as in all other countries, the iron trade is at present very heavily depressed, and this condition will continue until demand and supply, production and consumption, shall again be equal to each other. All over the world the production of iron and steel, and of iron and steel wares, now exceeds the demand. An improvement will only take place when either the production is lessened or when more is consumed. In many English districts hard times have been conducive to restrictions of working ; in other districts, however, attempts are manifest to neutralise the influence of low prices by a forced activity and increased production, tactics that will only have the effect of making the position worse. As England alone supplies nearly half of the world's demand for iron, her policy will determine how long this heavy crisis shall last ; because, although restriction of the production is also necessary in other countries, it is Great Britain alone, with her enormous export, which rules the prices in the markets of the world.

Sooner or later, however, normal times must return ; and as far as may be judged, English ironworks, as well as English collieries, will recover from their losses much quicker than their competitors abroad.

And certainly iron has a great future. In all civilised countries the demand for iron per head of the population has enormously increased, and yet there are many large countries which still make but little use of it, but which, as soon as their better judgment prevails and their purchasing power grows, will cause the question of over production in the iron trade to disappear immediately. England, with her favourable conditions of production and sale, is yet, and probably will be for a long

time, in a position to keep the competition of other nations at a distance, and will thus make the best of this increased consumption of iron. Notwithstanding the most energetic efforts lately made by other countries in developing their iron trade, experience has proved that even at home the race with England could not be won without a protective tariff.

Only Germany, of all the larger countries, has as yet attempted to abolish entirely her import duties on iron. The experiment has, however, seriously endangered the German ironworks, and it can hardly be doubted that the rash step will have to be retraced if the German empire is not prepared to give up entirely all idea of a sound and well-established iron industry of her own. North America, on the other hand, by means of a tariff (certainly excessive), has so far strengthened her iron trade that a very considerable import has been more and more lost to British works. Such experience will not be without influence in other countries, and the further export of iron from Great Britain will mainly depend upon the circumstance whether in cabinets and legislatures free trade or protectionist views prevail.

Whether, a few generations hence, one of the more advanced countries of Europe—perhaps Germany, Belgium, or Sweden—or, on the other side of the ocean, North America, will be able to compete with England in the markets of the world, is a difficult matter to predict. In certain specialities other countries too produce excellent work, especially some particular kinds of iron, which England produces in small quantities only. In such articles as wire, certain qualities of steel forgings, and rolled iron of special sections, art castings, certain descriptions of iron smallware, specialities in machine construction, &c., foreign countries will still maintain their natural preponderance. The cases where, in supplying neutral territory, English trade will meet with foreign competition, will also become more numerous. To win a decided preponderance in the markets of the world, such as England is actually exercising now, the production of large quantities, and the favourable conditions of production and disposal such as are at present only possessed by England, are absolutely necessary; and even if one or the other of these factors—for instance the supply of cheap coal, cheap labour, or the possession of the colonies—should fail, there still remains for England a sufficiently large number of advantages to retain, by unimpaired activity and energy, her world-renowned position for at least many decades to come.

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# FRANCE.

## 528,577 SQUARE KILOMETRES. 36,905,788 INHABITANTS.

## COAL.

THE beginning of coalmining in France may hardly be dated beyond the last years of the 18th century; it became important only recently, when the present process of iron manufacture and the production and application of steam-power were introduced from England, and the demand for mineral fuel increased beyond all expectation.

Although the contents of the French coalfields cannot be compared to those of England, Germany, and America, yet they are very much favoured by their geographical distribution, and, owing to the abundance of capital available for coalmining, they are worked in a business-like and careful manner.

This is particularly testified by the generally superior outfit of the French collieries, and has been still more facilitated by the protection provided against foreign competition in the form of a comparatively high import duty, and by the certainty that the demand for coal on French soil will always exceed any possible production.

Coalmining is carried on in three principal districts, which are situated in Northern, Central, and Southern France, and which exhibit considerable geological differences.

1. The *Valenciennes* basin, in the Département Pas-de-Calais, extends from the Belgian frontier into the neighbourhood of Boulogne-sur-Mer, and may be regarded as a continuation of the Belgian coalfield, of which a detailed description will be found in our article on Belgium.

The coal measures of this basin are found beneath a number of calcareous strata amounting to from 45 to 200 metres in thickness, which are difficult to be sunk through. The seams are numerous but irregular; their thickness, as in Belgium, is inconsiderable, never exceeding 1 metre, and averaging about 0·65 metres. Near Aniche twelve seams of an aggregate thickness of 7·30 metres, and near Anzin 18 seams of 10 metres thickness are found.

This coal deposit was discovered on the 28th July, 1734, within the boundaries of the parish last named, by the Vicomte DESANDROUIN, who had spent 17 years and his whole fortune in searching for coal. It contains the same varieties of coal as the Hainault coalfield in Belgium, which will be enumerated in their proper place.

2. The basins of *Central France* are, with regard to their geological structure, greatly different to those of the north. In the Creuzot and Blanzy concessions a seam, or rather a nearly vertical mass, is worked. It is of varying but always very considerable thickness, amounting to 24 and at several places even to 45 metres.

The Loire basin, which is at present the most important one in Central France, and contains the coalfields of Rive-de-Gier, Saint-Etienne and Commentry, extends over the whole narrow tract of country between the Rhône and the Loire, and on the opposite bank of the former river into the Département de l'Isère. The contents of the concessions vary considerably. Thus, for example, near Saint-Etienne 18 seams of 35 metres thickness are found, the number at other places being only 3, of scarcely 3 metres thickness.

Near Rive-de-Gier three seams are worked, dipping by 20° in a regular stratification, and with an average thickness of 9 to 10 metres.

The coal of Central France is generally of excellent quality; the caking varieties are, above all, in great demand by the iron and metal trades.

3. The coal seams in the basin of *Southern France*, which contains the Aveyron, and Rhône districts, are generally situated under favourable geological conditions. Near Alais the northern portion of the coal-measures is covered by the mica schists, which drop under the Lias formation towards east and south. The contents of this basin are, according to all probability, larger than those of Central France.

The coal of this basin is of a greatly varying quality; caking coal, suitable for coking, and open-burning coal, producing a short flame, being the most frequent descriptions. In the Département Aveyron the contents of the coal deposits are of a less satisfactory quality.

All over the south, as well as in Central France, coalmining has been succeeded by important industrial undertakings, of which we shall have to speak later on.

According to the last publication of the Direction des Mines the number of concessions existing on the 31st December, 1872, was 611, covering an area of over 5,418 square kilometres. They are distributed amongst 49 Départements as follows :—

| Départements. | Number and Area of Concessions. | | | | Départements. | Number and Area of Concessions. | | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. | Square Kilom. | Hects. | Ares. | | No. | Square Kilom. | Hects. | Ares. |
| Loire.. | 72 | 284 | 86 | .. | Vendée | 5 | 20 | 83 | .. |
| Gard | 55 | 517 | 65 | .. | Vosges | 4 | 92 | 31 | .. |
| Aveyron | 43 | 165 | 27 | .. | Vaucluse | 4 | 74 | .. | .. |
| Isère | 42 | 103 | 90 | .. | Corrèze | 4 | 31 | 6 | .. |
| Hautes-Alpes | 42 | 55 | 27 | 48 | Ain | 4 | 21 | 10 | .. |
| Savoie | 41 | 62 | 65 | 12 | Loire-Inférieure | 3 | 152 | 7 | .. |
| Hérault | 26 | 293 | 6 | .. | Dordogne | 3 | 26 | 13 | 75 |
| Saône-et-Loire | 24 | 441 | 94 | .. | Drôme | 3 | 14 | 36 | .. |
| Basses-Alpes | 22 | 60 | 37 | .. | Tarn | 2 | 91 | 31 | .. |
| Nord | 21 | 615 | 18 | .. | Jura | 2 | 13 | 70 | .. |
| Allier | 21 | 131 | 28 | 50 | Lot | 2 | 11 | 39 | .. |
| Pas-de-Calais | 20 | 520 | 50 | .. | Finistère | 2 | 7 | 35 | .. |
| Bouches-du-Rhône | 20 | 276 | 70 | .. | Landes.. | 2 | 5 | 14 | .. |
| Var | 14 | 81 | 2 | 21 | Calvados | 1 | 100 | 6 | .. |
| Mayenne | 11 | 130 | 38 | .. | Nièvre | 1 | 80 | 10 | .. |
| Puy-de-Dôme | 11 | 46 | 6 | .. | Manche | 1 | 47 | 61 | .. |
| Haute-Savoie | 11 | 30 | 91 | .. | Côte-d'Or | 1 | 11 | 41 | .. |
| Haute-Loire | 10 | 40 | 36 | .. | Deux-Sèvres | 1 | 4 | 50 | .. |
| Maine-et-Loire | 9 | 172 | 29 | .. | Doubs | 1 | 4 | 5 | .. |
| Haute-Saône | 9 | 125 | 87 | .. | Hautes-Pyrénées | 1 | 3 | 22 | .. |
| Ardèche | 8 | 91 | 27 | .. | Alpes-Maritimes | 1 | 1 | 36 | .. |
| Sarthe | 7 | 197 | 29 | .. | Basses-Pyrénées | 1 | 1 | 28 | .. |
| Rhône | 7 | 30 | 49 | .. | Pyrénées-Orientales. | 1 | .. | 31 | .. |
| Aude | 5 | 65 | 9 | .. | | | | | |
| Creuse | 5 | 33 | 72 | .. | Total | 611 | 5,418 | 25 | 6 |
| Cantal | 5 | 30 | 20 | .. | | | | | |

In the publication of the Government returns for the period ending December 31st, 1869, the number of concessions was stated as 623, and their area as 5,699 square kilometres 65 hectares. Accordingly both the number and the area of concessions have declined, a circumstance which can only be explained by the loss of Alsace-Lorraine.

The number of coalmines in active work, amounting in 1870 to 315, decreased in 1871 to 307, but rose in 1872 again to 310. The greatest depth reached by the mines in the latter year was:—

| | | | |
|---|---|---|---|
| In the Département du Nord | 630 | metres. |
| „ „ | Saône-et-Loire | 618 | „ |
| „ „ | Loire | 616 | „ |
| „ „ | Haute-Saône | 570 | „ |
| „ „ | Sarthe | 475 | „ |
| „ „ | Pas-de-Calais | 467 | „ |
| „ „ | Nièvre | 460 | „ |

For coalmining purposes 873 steam engines of 40,824 horse-power were at work. They are distributed amongst the different basins as follows:—

| | | |
|---|---|---|
| Loire | 11,304 | horse-power. |
| Pas-de-Calais | 7,259 | „ |
| Nord | 6,152 | „ |
| Saône-et-Loire | 5,460 | „ |
| Gard | 2,690 | „ |

The mechanical appliances and the number of miners employed at the French collieries have, according to the last complete returns, undergone the following changes:—

| Year. | No. of Mines Working. | Steam Engines. | | Miners. | |
|---|---|---|---|---|---|
| | | Number. | Horse-power. | Number. | Total of Wages per Annum. |
| 1866 | 324 | 838 | 35,237 | 79,909 | £2,524,592 |
| 1867 | 328 | 854 | 37,097 | 83,490 | 2,758,962 |
| 1868 | 324 | 871 | 38,563 | 84,909 | 2,825,545 |
| 1869 | 323 | 859 | 39,769 | 84,494 | 2,839,696 |
| 1870 | 315 | 877 | 40,550 | 82,673 | 2,887,465 |
| 1871 | 307 | 860 | 40,313 | 83,649 | 2,948,410 |
| 1872 | 310 | 873 | 40,824 | 91,899 | 3,600,145 |

In 1875 the output of coal in France amounted to 16,949,032 metric tons; in 1876 it increased to 17,104,794, but in 1877 it declined to 16,889,201 metric tons.

As the final returns for 1877 have not yet (April, 1878) been received by the statistical office, some of the following figures may possibly be not quite correct. It will be seen from the following table, however, at which approximate rate the different descriptions of coal go to make up the entire output in France:—

| Description. | 1876. | 1875. |
|---|---|---|
| | Metric Tons. | Metric Tons. |
| Anthracite | 1,123,161 | 1,087,136 |
| Open-burning Hard Coal | 3,183,144 | 3,253,290 |
| Caking and Smiths' Coal | 408,544 | 387,455 |
| Close-burning Coal | 8,574,216 | 8,451,635 |
| Flaming Coal, Open-burning | 3,350,134 | 3,344,077 |
| Lignite, &c. | 465,595 | 425,435 |
| Total | 17,104,794 | 16,949,028 |

Anthracite is principally mined in the Départements Calvados, Isère, Mayenne, Nord, and Sarthe; lignite in the Départements Bouches-du-Rhône, Isère, Haute-Saône, and Vaucluse. In the other basins coal only is mined.

The following are the coal basins from which more than 100,000 metric tons were raised in 1877:—

| | Metric Tons. | | Metric Tons. |
|---|---|---|---|
| Valenciennes | 6,565,824 | Brassac | 199,88[illegible] |
| Loire | 3,302,292 | Decize | 169,06[illegible] |
| Alais | 1,774,166 | Ronchamp | 168,7[illegible] |
| Creuzot et Blanzy | 1,101,805 | Ahun | 167,9[illegible] |
| Commentry | 843,849 | Saint-Eloy | 159,[illegible] |
| Aubin | 682,947 | Epinac | 142,[illegible] |
| Aix | 378,085 | Le Maine | 107,[illegible] |
| Carmaux | 281,500 | Le Drac | 10[illegible] |
| Graissesac | 263,808 | | |

The most prominent mining localities, arranged in the order of their importance, are the following:—

| | Metric Tons. | | Metric Tons. |
|---|---|---|---|
| Hardinghem | 87,651 | Langeac | [illegible],009 |
| Basse-Loire | 65,773 | Maurienne et Briançon | [illegible]9,002 |
| Vouvant et Chantonnay | 45,677 | Fréjus | [illegible]5,000 |
| Buxière-la-Grue | 40,486 | La Chapelle-sous-Dun | 24,665 |
| Manosque | 39,229 | Bagnols | 13,448 |
| Bert | 35,206 | Rodez | 12,347 |
| l'Argentière | 31,905 | Littry | 10,146 |

open to it. In 1872 365,000 metric tons of coal were shipped in the ports of France, the Alais basin participating in this amount at the rate of nearly 300,000 metric tons.

The following is a detailed chronological return of the import and export of mineral fuel :—

| Year. | Import. | | | | Export. | | | |
|---|---|---|---|---|---|---|---|---|
| | Quantity in Metric Tons. | | Value in £ | | Quantity in Metric Tons. | | Value in £ | |
| | Coal. | Coke. | Coal. | Coke. | Coal. | Coke. | Coal. | Coke. |
| 1802..... | 116,000 | | .. | .. | 25,000 | | .. | .. |
| 1811..... | 120,000 | | .. | .. | 30,000 | | .. | .. |
| 1820..... | 280,920 | | .. | .. | 26,456 | | .. | .. |
| 1830..... | 637,291 | | .. | .. | 6,012 | | .. | .. |
| 1840..... | 1,290,660 | | .. | .. | 37,331 | | .. | .. |
| 1850..... | 2,833,260 | | .. | .. | 41,560 | | .. | .. |
| 1860..... | 4,923,485 | ? | 3,560,264 | ? | 179,430 | ? | 87,032 | .. |
| 1866..... | 6,676,431 | ? | 5,147,810 | ? | 343,579 | ? | 157,854 | .. |
| 1867..... | 6,562,576 | 676,354 | 5,217,451 | 651,212 | 298,093 | 28,758 | 136,956 | 28,723 |
| 1868..... | 6,584,765 | 662,299 | 4,684,245 | 590,052 | 308,345 | 43,017 | 141,668 | 42,964 |
| 1869..... | 6,663,804 | 794,505 | 4,099,905 | 660 224 | 330,555 | 25,444 | 151,870 | 25,413 |
| 1870..... | 4,997,476 | 490,337 | 3,453,244 | 407,879 | 352,715 | 21,098 | 162,051 | 21,073 |
| 1871..... | 5,279,956 | 276,835 | 3,775,855 | 261,150 | 303,163 | 13,054 | 102,950 | 10,431 |
| 1872..... | 6,628,954 | 499,805 | 5,296,706 | 638,972 | 512,427 | 32,124 | 178,078 | 32.089 |
| 1873..... | 6,964,549 | 496,966 | 5,564,856 | 635,343 | 621,154 | 41,810 | 215,898 | 41,759 |
| 1874..... | 6,111,341 | 745,270 | .. | .. | 633,433 | 19,072 | .. | .. |
| 1875..... | 7,321,142 | 546,356 | .. | .. | 702,270 | 16,279 | .. | .. |
| 1876..... | 9,892,886 | 614,934 | .. | .. | 777,077 | 23,718 | .. | .. |

The quantities imported and exported during 1876 may be distributed as follows :—

| Import in Metric Tons. | | | | Export in Metric Tons. | | | |
|---|---|---|---|---|---|---|---|
| From | Coal. | Coke. | Total. | To | Coal. | Coke. | Total. |
| England ..... | 2,792,907 | .. | 2,792,907 | Belgium ..... | 84,622 | .. | 84,622 |
| Belgium ..... | 3,325,060 | 882,894 | 3,872,051 | Switzerland.... | 88,960 | 15,151 | 110,604 |
| Germany ..... | 771,555 | 223,883 | 1,091,388 | Italy ..... | 289,748 | 2,710 | 293.619 |
| Other Countries.. | 3,364 | 8,157 | 15,017 | Other Countries | 313,747 | 5,857 | 322,114 |
| Total ..... | 6,892,886 | 614,934 | 7,771,363 | Total .... | 777,077 | 23,718 | 810,959 |

It will be seen from this table that of the import of coal and coke into France Belgium has a share of 50 per cent, England of 36 per cent, and Germany of 14 per cent ; of the quantity exported from France Belgium only receives 10 per cent, Switzerland 14 per cent, Italy 36 per cent, and other countries (chiefly by sea) 40 per cent.

The Direction des Mines has published the following tabular review of the consumption of coal in France up to the end of 1872. The ever-varying stock of coal has been duly considered in fixing and determining the figures of production. The figures of import and export comprise both coal and coke together :—

| Year. | Production | Import. | Export. | Consumption. | Year. | Production | Import. | Export. | Consumption. |
|---|---|---|---|---|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. |
| 1787.. | 215,000 | 217,378 | 28,787 | 413,591 | 1866 . | 12,234,455 | 8,229,650 | 406,480 | 20,057,625 |
| 1802.. | 844,180 | 116,000 | 25,000 | 935,180 | 1867.. | 12,533,335 | 7,982,610 | 355,610 | 20,160,335 |
| 1820.. | 1,093,658 | 280,920 | 26,456 | 1,348,122 | 1868.. | 13,330,826 | 7,975,140 | 394,380 | 20,911,586 |
| 1830.. | 1,862,665 | 637,291 | 6,018 | 2,493,945 | 1869.. | 13,509,745 | 8,304,200 | 381,440 | 21,432,505 |
| 1840.. | 3,003,382 | 1,290,660 | 37,331 | 4,256,712 | 1870.. | 13,179,708 | 6,045,160 | 394,910 | 18,830,038 |
| 1850.. | 4,433,567 | 2,833,260 | 41,560 | 7,225,267 | 1871.. | 13,240,135 | 5.949,560 | 329,270 | 18,860,425 |
| 1860.. | 8,309,622 | 6,160,470 | 199,840 | 14,270,253 | 1872.. | 16,100,773 | 7,709,240 | 576,800 | 23,233,333 |
| 1865.. | 11,052,755 | 7,212,680 | 343,060 | 18,522,375 | | | | | |

Of the 18,830,040 metric tons consumed in 1870, 13,279,750 metric tons, or 70·5% were required by the ironworks; 2,798,070 metric tons, or 14·9% for domestic use; 1,903,150 metric tons, or 10·4% by railways and steam navigation; and the remainder of 789,060 metric tons, or 4·2%, by the mining and metal trades.

In 1871 the consumption increased only 30,380 metric tons, and the percentages just mentioned remained unchanged.

In 1872 the consumption rose considerably, owing chiefly to the increased activity of the ironworks. The consumption is to be distributed as follows:—

| | Metric Tons. |
|---|---|
| Ironworks, gasworks, mills and manufactories..... | 16,834,280 |
| Domestic use ..... | 3,096,040 |
| Railways and steam navigation..... | 2,385,900 |
| Mines and quarries ..... | 927,110 |
| Total..... | 23,233,330 |

According to the half-yearly (not definitive) returns published by the Government the consumption of 1875 and 1876 may be set down as follows:—

| Year. | Production. | Import. | Export. | Consumption. |
|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. |
| 1875 ..... | 16,949,032 | 8,176,012 | 660,678 | 24,464,366 |
| 1876 ..... | 17,104,794 | 8,101,650 | 725,525 | 24,480,919 |
| 1877 ..... | 16,889,201 | 7,771,863 | 810,959 | 23,849,605 |

We have not taken into account the fluctuations of the quantity of coal in stock, but judging from the former returns we may safely conclude that the consumption of France has, to say the least, not been affected by the crisis.

The consumption has to contend against severe restrictions imposed upon it partly by the import tariff and still more so by local taxation. The import duty on coal is 1s. per metric ton; this, however, is considerably increased by the "statistical registration duty," by the tax imposed on the transport of goods (formerly amounting to 5% of the freight, but abolished in March, 1878), and more than anything else by the duty levied by the municipal administrations, amounting, for example, in Paris to 5s. 9d. per ton. The different items of duty, &c., charged per ton of coal up to its delivery in the Paris coalyards, are estimated to amount to from 14s. 5d. to 16s.

The following is a summary of these items applying to coal purchased at Charleroi (Belgium), and carried to Paris (La Chapelle):—

| | |
|---|---|
| Price of coal at the pit's mouth..... | Variable |
| Transport on Belgian railways ..... | 1s. 10d. |
| Import and registration duty..... | 1s. 2d. |
| Transport on French railways and duty of 5% on it ..... | 6s. 3d. |
| Screening, unloading, and sacking..... | Variable |
| Loss by transport..... | Variable |
| Entrance duty in Paris ..... | 5s. 10d. |
| Conveyance, &c. ..... | Variable |
| Total of permanent extras ..... | 15s. 1d. |

It will be seen that these charges amount to a considerable sum, and that the exertions made to abolish the import and municipal duties are fully justified. At the same time we are bound to admire the great vitality of the French industry, which is generally thriving, in spite of this onerous burden imposed upon an indispensable commodity, of which one-third has to be supplied from abroad.

The following return of the steam engines in France is given by the statistical office of the Government :—

| Description of Engines. | | According to the Returns of | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1840 | 1850 | 1860 | 1866 | 1867 | 1868 | 1869 | 1870 | 1871 | 1872 |
| Stationary Engines.. | Number..... | 2,591 | 5,822 | 14,513 | 22,348 | 23,435 | 24,844 | 26,221 | 27,088 | 26,146 | 27,644 |
| | Horse-power.. | 84,350 | 66,642 | 177,652 | 274,798 | 289,409 | 306,156 | 320,447 | 336,030 | 315,884 | 338,328 |
| Locomotive Engines.. | Number..... | 142 | 973 | 3,101 | 4,130 | 4,435 | 4,591 | 4,822 | 4,835 | 4,867 | 5,102 |
| Marine Engines .... | Number..... | 263 | 501 | 681 | 804 | 859 | 897 | 917 | 973 | 1,005 | 1,048 |
| | Horse-power.. | 11,422 | 22,025 | 36,690 | 55,545 | 58,131 | 59,845 | 62,827 | 59,573 | 63,711 | 69,880 |

According to M. DUCARRE the number of steam engines working in France during 1875 exceeded 32,000 ; their aggregate horse-power was 900,000, of which 320,000 were used for manufacturing and mining purposes. As other 260,000 horse-power are supplied by water, the total motive power employed for industrial purposes in France comes up to 580,000 horse-power (of 75 kilogrammetres each). This immense power is controlled by 3,332,000 workmen, and utilised in creating an extra value of more than £500,000,000 per annnum.

## IRON.*

France possesses innumerable deposits of first-rate iron ores. The Vosges, the central tableland, the Alps, the Pyrenees, the Cevennes, and, more than all, Algeria, are very rich in ore-bearing strata, and their manganiferous ores, hematites, siderites, magnetic and specular ores of all descriptions, are fully equal to the analagous ores by which the iron trade is supplied from Spain and Italy.

These ores are found in regular or irregular veins, in beds and agglomerations, and in the whole series of geological formations. It would be beyond our province to give a detailed account of the exact position of the ore-bearing strata within this series, which, like the composition of the ores, is of the greatest influence on their commercial value.

At the end of the year 1869 there existed 266 ironstone mines, their superficial area being 1,302 square kilometres 21 hectares. At the time of the last official inquiry (December 31st, 1872) their number had decreased to 251, and their superficial area to 1,187 square kilometres 68 hectares 90 ares. This decrease is owing to the loss of Lorraine, which formerly had an important share of the total output of iron ores in France.

The present ironstone mines in France are distributed over 34 Départements, the following having the greatest area of concessions :—

| Département. | | | | |
|---|---|---|---|---|
| Gard | 232 | Square Kilos. | 85 | Hectares. |
| Meurthe-et-Moselle | 119 | „ | 51 | „ |
| Ardèche | 99 | „ | 20 | „ |
| Isère | 79 | „ | 37 | „ |
| Aveyron | 63 | „ | 4 | „ |

As regards their number and importance the ironstone mines of France are only second to the coalmines. They are, however, not the only source of supply of ores to the French iron trade, as many works purchase ores of higher quality from Spain, Elba, or Algeria, for the purpose of making a description of pig-iron more suitable for the manufacture of steel.

* LITERATURE.—MINISTÈRE DES TRAVAUX PUBLICS : Résumé des travaux statistiques de l'administration des mines, de 1834 jusqu' à 1872 incl. *Idem*, Chemins-de-fer français, situation au 31me Décembre, 1876.
*Journal Officiel*, April 7th, 1873.
*Bulletin du Comité des Maîtres de Forges de France.*
MAURICE BLOCK, Statistique de la France. 1875.
*La Houille*, journal hebdomadaire, industriel, commercial et financier. Paris, 1875, 1876, 1877, and the different numbers of 1878.

Besides these there are numerous outcrops from which a great portion of the demand of ores is supplied. Pursuant to the law of 1810 these workings were exempted from the right of concession claimed by the State, but liable to some regulations imposed upon them in favour of the concessioned ironworks, which, however, have been repealed in principle by the law of May 9th, 1866, and entirely abolished by that of the 1st of January, 1876.

The official statistical returns of the output of iron ores in France only comprise the period ending with the year 1872. In the course of that year 3,081,026 metric tons of a value of £542,883, or 3s. 5d. per ton, were raised, of which quantity 2,781,790 tons of a value of £586,789, or 4s. 2d. per ton, were actually worked into pig-iron. The import increased to the hitherto unattained quantity of 668,665 tons, the export at the same time amounting to 336,790 tons. The quantity actually used by the ironworks was accordingly 3,113,665 tons, against 2,958,490 tons in 1870 and 2,094,672 tons in 1871.

The following are the Départements exhibiting the highest productions :—

| Département. | 1870. | 1871. | 1872. |
|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. |
| Moselle | 810,074 | ..... | ..... |
| Meurthe | 404,403 | 505,837 | 1,012,101 |
| Haute-Marne | 325,472 | 293,954 | 421,254 |
| Cher | 201,580 | 245,076 | 320,000 |
| Ardèche | 230,502 | 208,573 | 229,041 |
| Saône-et-Loire | 190,382 | 173,318 | 175,309 |
| Pas-de-Calais | 123,349 | 123,000 | 132,970 |
| Meuse | 115,830 | 80,750 | 116,660 |

It will be perceived that in these Départements the output of ores during 1872 exceeded that of 1870, in spite of the greater portion of the late Département de la Moselle, where very rich ore deposits exist, having been lost in the meanwhile. The above-mentioned returns of the production only reach up to the end of 1872. The returns of the import and export of iron ores, which are to be found in the summary reports of the Custom-house officials, go beyond this time. In them, however, the information concerning the monetary value is wanting.

| Year. | Output. | | Import. | Export. |
|---|---|---|---|---|
| | Metric Tons. | Value in £ sterling. | Metric Tons. | Metric Tons. |
| 1850 | 1,821,170 | 259,233 | ..... | ..... |
| 1860 | 3,604,600 | 529,800 | ..... | ..... |
| 1866 | 3,790,168 | 545,060 | 450,273 | 137,480 |
| 1867 | 3,279,395 | 455,496 | 491,565 | 149,843 |
| 1868 | 3,005,094 | 417,912 | 553,563 | 195,440 |
| 1869 | 3,461,672 | 487,563 | 592,182 | 239,070 |
| 1870 | 2,899,593 | 412,056 | 489,261 | 145,062 |
| 1871 | 2,099,706 | 325,223 | 378,235 | 135,835 |
| 1872 | 3,081,026 | 542,883 | 620,518 | 336,790 |
| 1873 | ..... | ..... | 720,518 | 392,072 |
| 1874 | ..... | ..... | 816,110 | 213,263 |
| 1875 | ..... | ..... | 832,800 | 179,668 |
| 1876 | ..... | ..... | 975,631 | 105,170 |

The figures representing the output are the quantities of the raw ores. As a great portion of these have to be dressed before smelting their value increases but their weight decreases. Now, the official statistical returns add the import to the weight of the dressed ores and deduct from this sum the quantity exported, taking the remainder to represent the quantity of ores actually used

in France. This total quantity was 3,334,379 tons in 1865; in 1871 it decreased to 2,094,672 tons, and rose again to 3,113,665 tons in 1872.

The quantity of ores imported and exported during 1877 may be distributed amongst the countries concerned, as follows:—

| Export. | | Import. | |
|---|---|---|---|
| To. | Metric Tons. | From. | Metric Tons. |
| Belgium | 47,216 | Belgium | 223,443 |
| Germany | 30,104 | Germany | 30,709 |
| Other Countries | 1,791 | Spain | 248,226 |
| | | Italy | 139,775 |
| | | Algeria | 330,049 |
| | | Other Countries | 3,425 |
| Total | 79,111 | Total | 975,627 |

The iron industry has undergone some very important changes in the course of the last 15 or 20 years, which, however, have been effected for the greatest part by improvements of the manufacturing process, and accordingly cannot be perceived from mere statistical information concerning the total production.

The total number of blast furnaces existing in France in the year 1861 was 472; of these 282 were using charcoal, 77 a mixed fuel, and 113 were working with coke. In 1865 a considerable change had already taken place, 195 furnaces being worked with charcoal, 71 with a mixture of coke and charcoal, and 147 were using coke alone. A further diminution in the number of charcoal furnaces is shown in 1869, their number being only 91, and the furnaces using a mixed fuel having also decreased to 55. Lastly, in 1872 the total number of furnaces, having diminished during and after the war of 1870, increased again and almost approached the figures of 1869, there being a total of 270 blast-furnaces, 89 of them using charcoal, 135 coke, and the remaining 46 a mixture of both fuels. It would appear accordingly that the period of transition to which we have alluded is drawing to a close.

The following table gives the production and the import and export of *pig-iron* in France:—

| Year. | Production. | | Furnaces in Blast. | Import. | Export. |
|---|---|---|---|---|---|
| | Metric Tons. | Value in £. | | Metric Tons. | Metric Tons. |
| 1819 | 112,500 | ... | ... | ... | ... |
| 1830 | 266,361 | ... | ... | ... | ... |
| 1840 | 347,773 | ... | ... | ... | ... |
| 1850 | 415,653 | ... | ... | ... | ... |
| 1860 | 898,353 | ... | ... | ... | ... |
| 1866 | 1,260,348 | 5,268,966 | 354 | 143,167 | 23,944 |
| 1867 | 1,229,044 | 4,713,861 | 346 | 155,052 | 18,204 |
| 1868 | 1,235,308 | 4,526,782 | 311 | 107,280 | 21,868 |
| 1869 | 1,380,965 | 5,039,589 | 288 | 127,701 | 22,414 |
| 1870 | 1,178,114 | 4,348,025 | 266 | 83,589 | 16,594 |
| 1871 | 859,641 | 3,386,476 | 223 | 77,478 | 14,906 |
| 1872 | 1,217,838 | 5,902,666 | 270 | 122,931 | 36,146 |
| 1873 | 1,366,971 | ... | ... | 125,203 | 46,385 |
| 1874 | 1,423,308 | ... | ... | 122,338 | 51,846 |
| 1875 | 1,416,228 | ... | ... | 202,589 | ... |
| 1876 | 1,453,112 | ... | ... | 184,812 | ... |
| 1877 | 1,522,266 | ... | ... | 212,897 | ... |

It will be observed that the production of pig-iron in France has during a comparatively short lapse of time not only again reached the figure at which it stood previous to the war, but is, notwithstanding the present commercial crisis, on a steady increase even now. Coke pig-iron participates in the total production of 1877 to the extent of 1,369,869 metric tons; of the remainder 153,397 tons have been made by charcoal, and 63,281 tons by mixed fuel.

The following table enumerates the Départements where iron industry is carried on, and gives comparative figures showing the production during the years 1876 and 1877:—

| Département. | 1877. | 1876. | Département. | 1877. | 1876. |
|---|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | | Metric Tons. | Metric Tons. |
| Allier | 104,804 | 94,773 | Landes | 13,900 | 15,213 |
| Ardèche | 113,725 | 80,860 | Loire | 47,159 | 46,790 |
| Ardennes | 14,903 | 14,270 | Loire-Inférieure | 5,790 | 8,360 |
| Ariége | 12,995 | 20,920 | Lot-et-Garonne | 12,530 | 12,800 |
| Aube | .... | 120 | Marne | 3,126 | 2,923 |
| Aude | 293 | .... | Marne (Haute) | 86,129 | 84,119 |
| Aveyron | 28,137 | 29,713 | Mayenne | 2,066 | 2,055 |
| Bouches-du-Rhône | 23,546 | 22,500 | Meurthe-et-Moselle | 385,663 | 326,796 |
| Cher | 35,335 | 35,118 | Meuse | 13,679 | 17,615 |
| Corse | 4,700 | 4,800 | Morbihan | 1,985 | 2,535 |
| Côte-d'Or | 8,631 | 11,020 | Nord | 174,448 | 148,653 |
| Côtes-du-Nord | 1,829 | 1,475 | Pas-de-Calais | 54,040 | 60,239 |
| Dordogne | 2,800 | 5,490 | Pyrénées-Orientales | 8,537 | 7,907 |
| Doubs | 2,325 | 3,068 | Rhône | 61,797 | 69,794 |
| Eure | 4,494 | 4,352 | Saône (Haute) | 9,200 | 12,874 |
| Gard | 82,978 | 85,487 | Saône-et-Loire | 156,904 | 150,692 |
| Gironde | 2,935 | 5,500 | Sarthe | 906 | 842 |
| Ille-et-Vilaine | 1,736 | 1,979 | Savoie | .... | 285 |
| Indre | 8,980 | 8,997 | Tarn-et-Garonne | 4,281 | 5,350 |
| Isère | 20,653 | 22,097 | | | |
| Jura | 14,877 | 29,731 | Total | 1,522,266 | 1,453,112 |

A part of the annual production of pig-iron is re-melted in the manufacture of castings of a better description than those made directly from the blast-furnace.

The following is a tabular statement of the total weight and value and of the average price per ton of the castings made from cupolas and air furnaces:—

| Year. | Foundry Castings. | Total Value. | Average Value per Ton. |
|---|---|---|---|
| | Metric Tons. | £ Sterling. | £ Sterling. |
| 1865 | 252,654 | 2,667,836 | 11 |
| 1866 | 265,534 | 2,838,712 | 11 |
| 1867 | 269,949 | 2,761,778 | 10 |
| 1868 | 280,584 | 2,839,351 | 10 |
| 1869 | 303,921 | 3,107,117 | 10 |
| 1870 | 247,145 | 2,514,320 | 10 |
| 1871 | 221,598 | 2,370,983 | 11 |
| 1872 | 309,638 | 3,946,538 | 13 |

It may be assumed that the average value per ton of this description of castings is one and a half that of castings made from the blast-furnace.

The official statistical returns of France are, as we have already said, complete only up to 1872. The figures relating to the subsequent years, which have been or will be given in this report, have been published on account of the Administration des Mines in the *Journal Officiel*, and are only approximately correct, but the final returns are not likely to differ materially.

The following table gives a return of the iron production in France with regard to the description of fuel used in the manufacture:—

| Year. | Pig-Iron Made with Charcoal or Mixed Fuel. | Made with Mineral Fuel. | | | Total. | Value in £ Sterling. |
|---|---|---|---|---|---|---|
| | | Rails. | Merchant Iron. | Total. | | |
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | |
| 1819.... | 73,200 | .. | . | 1,000 | 74,200 | .. |
| 1822.... | 71,154 | .. | .. | 15,000 | 86,154 | .. |
| 1830.... | 101,290 | .. | .. | 46,855 | 148,469 | .. |
| 1840.... | 103,305 | .. | .. | 134,074 | 237,379 | .. |
| 1850.... | 73,457 | 23,087 | 149,652 | 172,739 | 246,196 | .. |
| 1860.... | 96,416 | 121,348 | 314,449 | 435,796 | 532,212 | .. |
| 1866.... | 74,489 | 171,007 | 573,887 | 744,894 | 819,383 | 7,781,972 |
| 1867.... | 68,825 | 172,482 | 534,971 | 707,454 | 776,278 | 6,939,565 |
| 1868.... | 52,829 | 186,028 | 574,871 | 760,899 | 813,728 | 7,165,903 |
| 1869.... | 55,226 | 216,628 | 631,866 | 848,494 | 903,720 | 8,137,069 |
| 1870.... | 45,933 | 171,009 | 613,844 | 784,853 | 830,786 | 7,445,406 |
| 1871.... | 37,316 | 122,504 | 517,590 | 640,094 | 677,411 | 6,441,722 |
| 1872.... | 43,263 | 129,151 | 710,935 | 840,086 | 883,349 | 10,293,438 |

Plates, sheets, and wire are not included in this table.

Since 1872 the production of iron has considerably decreased. In 1875 it amounted only to 755,442 metric tons, in 1876 to 733,404 tons, and in 1877 to 747,437 tons.

The quantities produced during the two last years may be made up from the different Départements, as follows :—

| Département. | 1877. | 1876. | Département. | 1877. | 1876. |
|---|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | | Metric Tons. | Metric Tons. |
| Allier | 26,398 | 24,799 | Meurthe-et-Moselle | 48,336 | 56,839 |
| Ardennes | 40,071 | 34,865 | Meuse | 16,186 | 12,500 |
| Ariége | 9,040 | 8,755 | Nièvre | 22,460 | 20,313 |
| Aube | 4,255 | 6,991 | Nord | 205,640 | 177,834 |
| Aveyron | 40,090 | 36,825 | Oise | 18,697 | 16,665 |
| Bouches-du-Rhône | 1,098 | 1,340 | Orne | 100 | 190 |
| Charente | 480 | 675 | Pas-de-Calais | 400 | 600 |
| Cher | 3,350 | 3,460 | Pyrénées (Basses) | 306 | 443 |
| Corse | 1,000 | 1,200 | Pyrénées-Orientales | 481 | 133 |
| Côte-d'Or | 14,067 | 15,045 | Rhin (Haut) | 2,670 | 1,131 |
| Côtes-du-Nord | 2,186 | 2,501 | Saône (Haute) | 1,300 | 2,057 |
| Dordogne | 4,942 | 4,482 | Saône-et-Loire | 53,187 | 50,993 |
| Doubs | 3,230 | 3,242 | Sarthe | 98 | 144 |
| Finistère | 400 | 477 | Savoie | 243 | 125 |
| Gard | 23,441 | 25,588 | Savoie (Haute) | 481 | 796 |
| Garonne (Haute) | 900 | 1,700 | Seine | 22,076 | 24,040 |
| Gironde | 650 | 944 | Seine-Inférieure | .. | 604 |
| Ille-et-Vilaine | 115 | 155 | Seine-et-Oise | 1,367 | 2,508 |
| Indre | 922 | 1,692 | Somme | 1,545 | 830 |
| Isère | 8,046 | 7,315 | Tarn | 544 | 726 |
| Jura | 9,896 | 16,711 | Tarn-et-Garonne | 3,255 | 4,975 |
| Landes | 2,750 | 2,556 | Vienne | 158 | 160 |
| Loire-et-Cher | 195 | 235 | Vienne (Haute) | 1,140 | .. |
| Loire | 56,536 | 56,990 | Vosges | 1,723 | 1,708 |
| Loire-Inférieure | 6,350 | 6,650 | Yonne | 10,770 | 9,681 |
| Lot-et-Garonne | 55 | .. | | | |
| Marne (Haute) | 73,808 | 82,203 | Total | 747,437 | 733,404 |
| Mayenne | 3 | 13 | | | |

The production of *rails* decreased to 118,959 tons in 1875, and 77,420 in 1876.

The production of *plates* and *sheets*, which is not comprised in the above returns, amounted

| | | | | |
|---|---|---|---|---|
| In 1865 | to 100,915 tons, | of a value of | ..... | £1,445,106 |
| „ 1866 | „ 106,054 | „ | „ ..... | 1,449,690 |
| „ 1867 | „ 97,538 | „ | „ ..... | 1,299,276 |
| „ 1868 | „ 92,023 | „ | „ ..... | 1,193,152 |
| „ 1869 | „ 107,441 | „ | „ ..... | 1,379,073 |
| „ 1870 | „ 83,102 | „ | „ ..... | 1,080,154 |
| „ 1871 | „ 80,701 | „ | „ ..... | 1,143,430 |

In 1872 this branch of the iron trade, as well as the manufacture of castings, was exceedingly brisk, the production attaining the figure of 129,823 tons, of a value of £2,184,963. It has also fairly well withstood the subsequent crisis and the powerful influence of foreign competition, the production of plates and sheets being 114,931tons in 1875, in 1876 it was 115,136 tons, and in 1877 125,361 tons.

The production of the two last years has been contributed by the Départements concerned as follows:—

| Département. | 1877. | 1876. | Département. | 1877. | 1876. |
|---|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | | Metric Tons. | Metric Tons. |
| Aisne | 796 | 875 | Meuse | 240 | .... |
| Allier | 6,576 | 8,014 | Morbihan | 4,346 | 3,069 |
| Ardennes | 18,392 | 18,070 | Nièvre | 1,394 | 1,362 |
| Aveyron | 1,390 | 2,992 | Nord | 24,674 | 18,994 |
| Côte-d'Or | 550 | 1,300 | Oise | 13,107 | 11,100 |
| Doubs | 3,109 | 3,423 | Saône (Haute) | 775 | 1,018 |
| Garonne (Haute) | 300 | .... | Saône-et-Loire | 15,978 | 16,808 |
| Isère | 1,398 | 1,059 | Savoie (Haute) | 359 | 422 |
| Jura | 3,826 | 3,432 | Vosges | 1,342 | 1,252 |
| Loire | 15,143 | 16,145 | | | |
| Marne (Haute) | 5,267 | 4,901 | Total | 125,361 | 115,136 |
| Meurthe-et-Moselle | 1,400 | .... | | | |

The production of *iron wire* likewise is not contained in the general tabular statement previously given, as we have no returns relating to it since 1872. In 1865 it amounted to 43,149 tons, of a value of £740,795, and it increased in 1866 to 59,585 tons, of a value of £1,028,236. In 1867 there was a slight decline, the production being only 57,453 tons, of a value of £945,099.

In 1868 an advance is recorded, the figures being 62,770 tons and £975,445, and for 1869 again a decline, production and value however being maintained at the height of 56,037 tons and £903,875 respectively. But in 1870 we notice the influence of the war, the same as in the case of all other branches of industry, the production falling off to 42,387 tons, and its value to £663,433. In 1871 the production of wire rose again to 46,615 tons, of a value of £800,263, and in 1872 it attained the hitherto unknown amount of 72,629 tons, of a value of £1,512,342.

Generally speaking the iron manufactures of France have, in the fifty years' interval from 1819 to 1869, increased to a twelvefold amount (from 74,200 to 903,720 tons); since 1869, however, the production of iron is declining, but only to give way to the increasing production of steel, of which we have now to speak.

All *steel* is divided by the statistical office into five descriptions—raw (German) steel, puddled steel, Bessemer, Siemens, and Martin steel, blister steel, and finally cast steel.

Raw (German) steel is made in open fires, and from some special descriptions of pig-iron.

Puddled steel is sufficiently defined by its denomination.

Bessemer, Siemens, and Martin steel is produced by decarbonisation at a temperature sufficient to keep the entire quantity operated upon in a fluid state, and to permit it to be run into ingots of homogeneous texture.

Blister steel is produced by causing wrought-iron to assimilate with carbon; this is effected by bringing it in contact with powdered charcoal and exposing it to an adequate heat.

Lastly, cast steel is produced by melting together previously determined quantities of different descriptions of steel, or certain other compounds (as, for instance, pig and wrought iron or scrap, pig-iron and steel), either in crucibles or in a regenerative or some other description of furnace.

The first of these processes is no longer of any importance—apparently it will soon be discarded entirely.

Puddled steel is maintaining its ground better, chiefly in the Loire district,

where nearly 60% of the whole quantity of French puddled steel is produced. The entire production increased to 19,237 tons in the year 1876.

The descriptions of steel produced by the Bessemer, the Siemens, and the Martin processes are of the greatest importance, and the extent of these manufactures has enormously increased. The aggregate quantity of these descriptions of steel was, in 1865, 9,647 tons, of the value of £192,037, at the rate of £19·91 per ton. In 1866 the production is almost identical, being 9,977 tons, of the value of £203,476, or £20·39 per ton. In 1867 this branch of steel manufacture advanced considerably, the production being 17,768 tons, the value £342,456, or £19 per ton. In 1868 the increase was again enormous, the production rising to 45,860 tons, and the value to £725,719; at the same time the average price per ton had declined one-sixth, £15·82. In 1869 the production attained the figure of 70,113 tons, of the value of £880,651, the average price per ton showing a further decline to £12·56. In the two following years the production decreased, in consequence of the war, to 61,242 and 62,382 tons, corresponding to £699,328 and £738,939; but in the next year (1872) the production rose again to 112,286 tons, and the value to £1,594,353, the average price per ton being £14·20; and from that time the production has steadily increased, being 231,468 tons in 1875, and 231,999 tons in 1876. In 1877, however, there was a slight decline, owing to the commercial crisis, and steel rails were sold at the end of that year at £8 per ton.

Lastly, cast-steel, which is used for a great many special purposes, is produced in somewhat large and nearly unvarying quantities. The entire quantity produced in France was 8,135 tons in the year 1870, of the value of £239,349; in 1871 it decreased to 5,959 tons, and the value to £178,676; in 1872 it rose again to 8,080 tons, of the value of £305,531, the average price per ton being £37·81. The greatest portion of it is produced in the Département de la Loire.

How the manufacture of steel has gradually risen from the year 1831, and obtained more and more footing in the French market, will be seen from the following table :—

| Year. | German, Puddled, Bessemer, Martin, &c., Steel. | | Blister Steel. | Cast Steel. |
|---|---|---|---|---|
| | Metric Tons. | | Metric Tons. | Metric Tons. |
| 1831 | 3,257 | | 1,500 | 158 |
| 1840 | 3,546 | | 3,859 | 858 |
| 1850 | 3,307 | | 5,625 | 2,050 |
| 1860 | 16,917 | | 6,414 | 6,518 |
| 1866 | 26,626 | | 5,019 | 6,119 |
| 1867 | 36,041 | | 4,416 | 6,020 |
| 1868 | 66,907 | | 4,304 | 9,353 |
| 1869 | 96,305 | | 6,310 | 7,610 |
| 1870 | 81,023 | | 5,229 | 8,135 |
| 1871 | 76,454 | | 3,714 | 5,959 |
| 1872 | 129,903 | | 3,722 | 8,080 |
| 1873 | ... | 155,568 | ... | ... |
| 1874 | ... | 216,072 | ... | ... |
| 1875 | 249,592 | | 2,045 | 6,143 |
| 1876 | ... | 224,473 | ... | 7,774 |
| 1877 | ... | 221,817 | ... | 6,843 |

The extent to which the French steel manufacturers are making use of the different processes is likewise exhibited by this table.

The following table shows the share the several Départements are taking in the entire production of the different descriptions of steel. Here the manufacture of steel plates and sheets has also been taken into account :—

| Département. | Bessemer, Puddled, German, and Blister Steel. | | Cast Steel. | | Steel Plates and Sheets. | |
|---|---|---|---|---|---|---|
| | 1877 Metric Tons. | 1876 Metric Tons. | 1877 Metric Tons. | 1876 Metric Tons. | 1877 Metric Tons. | 1876 Metric Tons. |
| Allier | 17,681 | 14,050 | .. | .. | 144 | 37 |
| Ardennes | 86 | 75 | 355 | 47 | .. | .. |
| Ariége | 1,809 | 1,802 | 23 | 21 | .. | 60 |
| Charente | 670 | 770 | 20 | .. | .. | .. |
| Côtes-du-Nord | 21 | 25 | 7 | 11 | .. | .. |
| Finistère | .. | .. | .. | 4 | .. | .. |
| Gard | 29,616 | 27,981 | .. | .. | .. | .. |
| Garonne (Haute) | 145 | 840 | .. | .. | .. | .. |
| Isère | 5,780 | 5,513 | 144 | 124 | .. | .. |
| Loire | 78,859 | 93,174 | 5,751 | 6,561 | 5,347 | 3,154 |
| Meurthe-et-Moselle | 1,129 | 1,030 | .. | .. | .. | .. |
| Nièvre | 10,258 | 6,263 | 139 | 897 | 691 | .. |
| Nord | 29,729 | 20,896 | .. | .. | 255 | .. |
| Saône (Haute) | .. | 23 | .. | 21 | .. | .. |
| Saône-et-Loire | 45,904 | 52,058 | .. | .. | 6,851 | 4,905 |
| Seine | .. | .. | 31 | 88 | .. | .. |
| Tarn | 135 | 93 | 378 | .. | .. | .. |
| Vosges | 5 | .. | .. | .. | .. | .. |
| Total | 221,817 | 224,473 | 6,843 | 7,774 | 13,288 | 8,156 |

We have before mentioned the decrease in the number of the blast-furnaces. It is proved by the latest returns that the number of works engaged in a further conversion of pig-iron is also diminishing. The number of Catalan hearths is continually decreasing. Of the 24 forges existing in 1869 only 22 remained in 1870, 21 in 1871, and 20 in 1872. In 1869 the number of puddling furnaces was 1,111; in 1870 it declined to 1,073, and in 1871 to 902. In 1872, however, it increased again to 1,037.

If we regard the manufacture of steel from this point of view we are forced to conclude from the official returns that the manufacture of raw (German) steel is coming into disuse. In 1869 there were 49 forges carrying on this manufacture, their number decreasing in 1870, 1871, and 1872, to 37, 20, and 4. The number of converting furnaces has been changed almost at the same rate as those of the blast and puddling furnaces, being 53 in 1869, 47 in 1870, 43 in 1871, and 44 in 1872. The melting furnaces used for manufacturing cast-steel are rapidly disappearing. Their numbers in the years 1869, 1870, 1871, and 1872 were 287, 281, 235, and 212 respectively. This diminution must chiefly be attributed to the increasing disuse of the melting-holes for crucible steel.

These considerable changes in the manufacture of steel are only due to the introduction of the important inventions made by Mr. Bessemer and others. In 1876 there were 10 works in France manufacturing steel by some one or other of these new processes, and having altogether 26 converters and 25 Martin furnaces, viz., the works of the Chatillon-Commentry Company, with 2 converters; the Commentry-Fourchambault Company, with 5 converters; the Denain-Anzin Company, with 2 converters; the Campagnie des hauts-fourneaux, forges et aciéries de la Marine et des Chemins-de-fer (Pétin, Gaudet, and Cie.), with 3 converters; Messrs. Biétrix and Cie., at Saint-Étienne, with 2 Martin furnaces; the Campagnie des forges, fonderies et aciéries de Saint-Etienne, with 2 converters; the Creuzot Works, with 4 converters and 5 Martin furnaces; the Campagnie de Terre-noire-Lavoulte-Bessèges, with 8 converters and 8 Martin furnaces; and the Clergué Works, at Oullins, with 2 Martin furnaces.

The following compilation of the returns of the import (free and subject to duty) and of the export (free or against "acquits-à-caution") of pig-iron, hardware, plates, sheets, and steel for 1876 and 1877, will afford a review of the present commercial situation of the French iron trade:—

| Import. | 1877. | 1876. |
|---|---|---|
| *Pig-iron—* | Metric Tons. | Metric Tons. |
| Duty free (according to decree of Feb. 15th, 1862) | 95,578 | 99,112 |
| For Shipbuilding | 843 | 2,112 |
| Duty on | 116,475 | 83,089 |
| Total | 212,896 | 184,313 |
| *Hardware, Plates, and Sheets—* | | |
| Duty free (as above) | 23,620 | 24,443 |
| For Shipbuilding | 5,356 | 7,989 |
| Duty on | 33,758 | 23,951 |
| Total | 62,734 | 56,383 |
| *Steel—* | | |
| Duty free (as above) | 467 | 712 |
| For Shipbuilding | 2 | 10 |
| Duty on | 4,538 | 4,722 |
| Total | 5,007 | 5,444 |

| Export. | 1877. | 1876. |
|---|---|---|
| | Metric Tons. | Metric Tons. |
| Total of Pig-iron, Hardware, Plates, and Sheets, against "acquits-à-caution" | 102,866 | 125,293 |
| Steel, against "acquits-à-caution" | 2,071 | 1,194 |
| Iron Plates and Sheets, Steel and Artistic Objects, direct | 64,767 | 79,760 |
| Total | 169,204 | 206,247 |

The quantities imported in 1877 either for shipbuilding purposes or against "acquits-à-caution" were as follows:—

| | Duty Free. | Against Acquits-à-caution. |
|---|---|---|
| | Metric Tons. | Metric Tons. |
| Scrap-iron | 105 | 10 |
| Pig-iron | 843 | 191 |
| Merchant Iron | 5,104 | 905 |
| Plates and Sheets | 251 | 300 |
| Bar Steel | 2 | ... |
| Steel Plates and Sheets | 47 | ... |
| Machinery | 259 | 1,184 |
| Wrought-iron Hardware | ... | 2,645 |
| Cast-iron Hardware | ... | 403 |
| Steel Hardware | ... | 36 |
| Plate-ware | ... | 1,276 |
| Anchors | 162 | 170 |
| Cables and Chains | 143 | 611 |
| Total | 6,916 | 7,731 |

Of the quantity imported under "acquits-à-caution" 34,389 tons remained unused at the end of last year.

# BELGIUM.*

## 29,455 SQUARE KILOMETRES. 5,403,006 INHABITANTS.

## COAL.

BELGIUM may be said to be one of the countries most favoured by mineral wealth, if we take the limited extent of its area into account. It is also the country where mining operations have been carried on in more remote ages than anywhere else, England perhaps excepted.

The beginnings of coalmining in Belgium date back as far as the twelfth century. The coal measures follow the dip of the carboniferous limestone, and form a deep trough. Their "strike" is from S.W. to N.E., from Quiévrain, Mons, Charleroi, to Namur and Liége.

The coal is cropping out at the saddleback on the Samson brook, near Namur. From this point the strata are dipping towards west and towards east, forming the Hainault and the Liége basin.

It is in consequence of this formation that as the distances increase from Namur towards the east and west the coal measures are settling down to greater and greater depths. The lowest strata of the coal measures are cropping out near Samson at an elevation of about 200 metres *above* the level of the sea. The deepest point of the trough is supposed to be near Boussu, westward from Mons, at 2,370 metres *below* the level of the sea; near Liége, also, the coal measures go down to a very considerable depth, although not so far as near Mons.

The quantity of coal is supposed to be equal to about one-fortieth of the entire cubic contents of the coal-bearing strata, which are extending over an area of 134,110 hectares ($=\frac{1}{22}$ of the area of the whole country).

The number of coal seams existing below a certain point of a coal basin is usually proportionate to the depth of the vertical section of the coal measures at the same point. Accordingly the coal seams are less numerous in the vicinity of Namur, and their number, and with it the number of mines, increases as the distances from Liége and Mons become less.

According to M. DUMONT the number of seams in the neighbourhood of Liége is 85, and according to M. T. L. CORNET there are 130 to 160 different seams known in the "Borinage," two-thirds of which are workable. The thickness of these seams varies from a few centimetres to two metres, and those which are actually worked are from 0·55 to 1 metre thick. Seams less than 0·35 to 0·40 metres thick are not worked at all.

Although the seams are very numerous, and contain almost every description of mineral coal, much difficulty is experienced in working them, in consequence of their inconsiderable thickness, and of the great number of faults in them. It must also be mentioned here that the seams have a rather strong dip to the south, extending uniformly along the whole "strike" from the Pas de Calais to Prussian Rhineland.

These geological disadvantages are further aggravated by difficulties of another description, resulting from the great age of the workings, the continually

* Contributed by MAX GOEBEL, C.E., and publisher of "La Semaine Industrielle" in Liége.

LITERATURE.—MICHEL MOURLON, *Patria Belgica*, article "Géologie."

T. L. CORNET, idem, article "Mines et Carrières."

T. JOCHAMS ET HENRI WITMEUR, Statistique des industries minières et sidérurgiques de Belgique, pour l'exercice 1875.

JULES VAN SCHERPENZEEL-THIM, Rapport sur la situation de l'industrie minérale et métallurgique dans la province de Liége, pendant l'année 1876.

EMILE LAGUESSE, Rapport de M. l'Ingénieur-en-chef des mines, province de Hainault, année 1876.

BERCHEM, Situation de l'industrie minérale dans la province de Namur, pendant l'année 1876.

Tableau général du commerce de la Belgique avec les pays étrangers, pendant l'année 1876. Publié par le Ministre des Finances.

Moniteur belge du 8 Février 1878, annexe, tableau du mouvement commercial de la Belgique avec les pays étrangers, pendant les années 1877, 1876, et 1875.

increasing depth of the shafts, the disturbance of the overlying strata, and the accumulation of water in the old workings. Everything considered, we are bound to admit that coalmining is carried on in Belgium with creditable energy, as the coal trade of that country is exposed to a severe competition of neighbouring districts which are more favoured by nature.

The several descriptions of Belgian coal exhibit considerable difference in regard to their structure as well as to their chemical composition. They have been classified into four groups, which are given here in their natural succession.

1. *Open-burning coal* is got from the lower seams, and is chiefly used for brickmaking and limeburning, for calcining pyrites, the reduction of zinc ores, and the preparation of artificial fuel. The larger pieces are sold for domestic purposes.

2. *Caking coal* is separated from the former by several intermediate descriptions. It is a fairly good household and a first-rate smiths' coal; besides, it is very suitable for coking, the coke made from it being of a hard and heavy description, and in good demand for the blast furnaces.

3. *Close-burning coal* is principally used as steam coal, for domestic purposes, and gas and coke making. It yields a softer coke than the former, and less gas than the following description.

4. *Flaming coal* (*flénu*) is in great demand for all purposes where a long flame and an intense heat is required. The greatest portion of this coal is used for steam navigation, puddling furnaces, for burning fire-bricks and pottery, for glassworks and gas-making. Several descriptions of Mons coal have yielded 330 cubic metres of gas per metric ton.

If we divide the entire output of the kingdom (amounting to 14,329,578 metric tons in 1876) according to these four descriptions, we obtain the following percentage: Open-burning coal, 12 per cent; close-burning coal, 45 per cent; caking coal, 27 per cent; and flaming coal, 16 per cent.

The structure of Belgian coal exhibits the same differences as its chemical composition. The yield of cops and round coal is comparatively small, and collieries where it amounts to 40 per cent of the output are only exceptionally met with.

It is not likely that the number of concessions in Belgium will much increase; on the contrary, it will be seen from the following table that, notwithstanding a slight increase of the concessioned areas, the number of collieries has become less, in consequence of consolidation :—

| Year. | Collieries. | | | | | |
|---|---|---|---|---|---|---|
| | Working. | | Dormant. | | Total. | |
| | Number. | Area, Hectares. | Number. | Area, Hectares. | Number. | Area, Hectares. |
| 1866 ..... | 155 | 86,051 | 132 | 48,711 | 287 | 134,762 |
| 1869 ..... | 171 | 92,483 | 114 | 48,157 | 285 | 140,640 |
| 1872 ..... | 166 | 94,877 | 116 | 46,331 | 282 | 141,208 |
| 1873 ..... | 180 | 103,301 | 102 | 37,907 | 282 | 141,208 |
| 1874 ..... | 179 | 101,109 | 105 | 43,203 | 284 | 144,312 |
| 1875 ..... | 175 | 100,652 | 105 | 43,226 | 280 | 143,878 |
| 1876 ..... | 180 | 103,628 | 98 | 39,030 | 278 | 142,658 |

Here we may remark that in the province of Hainault concessions exist for working only some few of the entire number of overlying seams. It will also appear from the following table that the number of mines has diminished at the same rate as the depths of the workings increased. This decrease was stayed by the brisk state of trade in 1873, and a number of new mines, which were laid out to meet the exceptionally heavy demand, have lately been actively worked; but as a matter of course it would be a great advantage to the Belgian coal trade if the number of pits was reduced and the underground workings extended at the same time.

In the following table we give the number of the workings, and the depths of the shafts :—

| Year. | Workings. | | | | Shafts. | | | Mean Depth of Lowest Level. Metres. |
|---|---|---|---|---|---|---|---|---|
| | At Work. | Dormant. | In course of Opening. | Total. | Winding. | Pumping. | Total. | |
| 1866.. | 335 | 101 | 56 | 492 | 49 | 196 | 245 | 308 |
| 1869.. | 310 | 108 | 38 | 456 | 47 | 190 | 237 | 334 |
| 1872.. | 317 | 86 | 39 | 442 | 48 | 186 | 234 | 344 |
| 1873.. | 317 | 78 | 57 | 452 | 45 | 186 | 231 | 346 |
| 1874.. | 317 | 82 | 58 | 457 | 45 | 184 | 229 | 355 |
| 1875.. | 322 | 88 | 59 | 463 | 47 | 183 | 230 | 350 |
| 1876.. | 306 | 88 | 60 | 454 | 49 | 172 | 221 | 340* |

But the mechanical outfit of the mines, the winding and pumping arrangements and the mine ventilators, have required enlargement from year to year, the increase of the number as well as of the power of the engines amounting to nearly 50 per cent during the last ten years.

| Year. | Steam Engines. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | For Winding. | | For Pumping. | | For Ventilation. | | Divers Purposes | | Total. | |
| | No. | HP. | No. | HP. | No. | HP. | No. | HP. | No. | HP. |
| 1866 | 421 | 27,412 | 170 | 28,136 | 266 | 5,076 | 332 | 2,768 | 1,189 | 64,022 |
| 1869 | 428 | 33,034 | 176 | 28,441 | 304 | 7,916 | 457 | 4,095 | 1,365 | 73,486 |
| 1872 | 481 | 35,912 | 183 | 30,935 | 309 | 8,861 | 522 | 5,164 | 1,445 | 80,872 |
| 1873 | 430 | 37,111 | 185 | 31,967 | 323 | 9,742 | 557 | 5,535 | 1,495 | 84,355 |
| 1874 | 450 | 39,398 | 182 | 31,447 | 337 | 10,895 | 617 | 6,612 | 1,586 | 88,352 |
| 1875 | 461 | 41,939 | 178 | 30,949 | 349 | 11,692 | 675 | 7,733 | 1,663 | 92,313 |
| 1876 | 481 | 46,575 | 189 | 31,828 | 361 | 12,810 | 736 | 8,669 | 1,766 | 99,382 |

Circumstances which are clearly demonstrated by these figures—the increase of the depths of the shafts and of the engine power, and the steady advance of the rate of wages—have kept the prime cost of Belgian coal at a considerable height.

If we compare the great difficulties imposed upon Belgian coalmining by merely geological conditions to those experienced in England, Germany, and even France on the same account, we are bound to admit that the prime cost previous to the rise of 1872-74 was not at all exorbitant. The heavy demand of these years caused it to rise rapidly, but unfortunately the decline, after the prosperous days had passed, was as insignificant here as elsewhere. Thus, for instance, the working expenses of all collieries remained nearly stationary in 1874 and 1875, being £8,707,000 in the former and £8,667,000 in the latter year. The value of the production, however, declined from £9,626,000 to £9,186,000, causing a loss of £440,000. This is particularly shown in the following table :—

| Year. | Total Expenses. | | | Extraordinary Expenses. | Price per Ton resulting from | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Wages. | Other Expenses. | Total. | | Regular Working Expenses. | | Extraordinary Expenses. | | Diverse Expenses. | |
| | £ | £ | £ | £ | s. | d. | s. | d. | s. | d. |
| 1866.... | 3,005,519 | 2,103,401 | 5,094,250 | 556,077 | 7 | 1 | 0 | 10 | 8 | 0 |
| 1869.... | 2,980,283 | 2,136,758 | 5,117,041 | 658,152 | 6 | 10 | 1 | 1 | 7 | 11 |
| 1872.... | 4,137,108 | 2,775,687 | 6,912,795 | 633,407 | 8 | 0 | 0 | 10 | 8 | 10 |
| 1873.... | 5,831,572 | 3,922,236 | 9,753,809 | 1,118,616 | 10 | 11 | 1 | 5 | 12 | 8 |
| 1874.... | 5,188,590 | 3,518,697 | 8,707,296 | 1,262,006 | 10 | 2 | 1 | 9 | 11 | 10 |
| 1875.... | 5,146,135 | 3,521,052 | 8,667,188 | 1,204,273 | 9 | 11 | 1 | 7 | 11 | 6 |
| 1876.... | 4,469,307 | 3,133,994 | 7,604,300 | 1,078,523 | 9 | 1 | 1 | 5 | 11 | 7 |

* If this last figure had been ascertained in accordance with the method pursued in previous years it would have been 370.

The number of miners employed in the Belgian collieries during the year 1850 was 47,949; in 1860 it increased to 78,232, and in 1865 to 82,368. This steady increase may be observed from the following table, containing also the average wages per annum. We beg to direct the attention of the reader to the abruptness between the figures for 1872 and those of the previous and following years. It will be observed that this difference is much greater still, if we consider the wages of the miners proper only, without those of the banksmen, &c.—the difference of the years 1871 and 1873 amounting in this case to 56 per cent.

| Year. | Horses Working. | | | Workmen. | | | | | Average Wages per Annum. |
|---|---|---|---|---|---|---|---|---|---|
| | Below Ground. | Above Ground. | Total. | Below Ground. | | Above Ground. | | Total Number. | Average Wages.* |
| | | | | Number. | Average Wages.* | Number. | Average Wages.* | | |
| | | | | | s. d. | | s. d. | | s. d. | £ s. d. |
| 1868.... | 2,150 | 1,450 | 3,600 | 68,722 | 2 4 | 20,660 | 1 8 | 89,382 | 2 2 | 32 2 7 |
| 1869.... | 2,235 | 1,438 | 3,673 | 68,875 | 2 5 | 21,053 | 1 9 | 89,928 | 2 3 | 33 3 1 |
| 1870.... | 2,253 | 1,471 | 3,724 | 71,374 | 2 5 | 20,619 | 1 9 | 91,993 | 2 3 | 35 1 2 |
| 1871.... | 2,436 | 1,499 | 3,935 | 72,644 | 2 6 | 21,642 | 1 9 | 94,286 | 2 4 | 34 10 6 |
| 1872.... | 2,679 | 1,598 | 4,277 | 76,232 | 3 0 | 22,631 | 2 0 | 98,863 | 2 9 | 41 16 2 |
| 1873.... | 2,953 | 1,791 | 4,744 | 83,065 | 3 10 | 24,837 | 2 3 | 107,902 | 3 6 | 54 0 8 |
| 1874.... | 3,083 | 1,912 | 4,995 | 84,634 | 3 6 | 24,997 | 2 3 | 109,631 | 3 3 | 47 5 9 |
| 1875.... | 2,917 | 1,759 | 4,676 | 84,732 | 3 4 | 25,988 | 2 2 | 110,720 | 3 1 | 46 9 1 |
| 1876.... | 2,933 | 1,735 | 4,668 | 82,766 | 3 7 | 25,777 | 2 1 | 108,543 | 2 10 | 41 3 6 |

The condition of the labouring classes, especially of the miners, has justly engaged the serious attention of the Government and of the leading men in the trade. Particular care is taken by the Government for the safety of the miner, considering the manifold dangers to which he is exposed. Owing to the excellent regulations, an unremitting watchfulness, and to the co-operation of the mining engineers and of the highly intelligent men who are entrusted with the difficult task of managing collieries, mining operations in Belgium are at present carried on in perfect accordance with the conditions necessary to insure the safety of the miner, as far as this is possible; and in consequence of this the number of accidents in mines is in all provinces diminishing from year to year.

Nearly all collieries belong to the existing six miners' unions. One-half of the contributions to these unions is supplied by deductions from the miners' wages, the other half by the mine-owners and by a subvention on the part of the State. As, however, the relief afforded by the unions is in most cases insufficient, individual societies have been established at most of the mines, which are exclusively maintained by deductions from wages, and by which the costs of medical attendance and of a temporary support to wounded and sick miners, and to the families bereaved by accident, are defrayed. The miners who are incapacitated by accident receive a portion (sometimes half) of their wages, either until their recovery or until they are relieved by the unions, in case of their incapacity lasting longer than two months.

The subventions are generally adequate to the wants of the sick and their families; particular regulations as to their distribution do not exist. The revenues of these friendly societies are nearly the same as those of the unions. But as the former have to meet the sudden exigencies of immediate relief, their expenses are often in excess of their revenue, in which case the deficiency is covered by the mine-owners. The subventions paid annually by the unions and the societies amount to £16 5,000.

The whole Belgian coalfield has been divided by the administrative authorities into five districts, which sometimes have erroneously been termed "basins." They are the Mons or Pborinage district, that of the Centre, the districts of

* These are the average wages of men, women, boys, girls, and children of both sexes.

Charleroi, of Basse-Sambre or Namur, and lastly that of Liége, containing Huy, Seraing, and the tableland of Herve.

The following table shows the output of 1876, distributed according to the provinces and districts :—

| Province. | District. | Output in Metric Tons. | Percentage of Total Output. |
|---|---|---|---|
| Hainault ..... | Mons ..... | 3,728,960 | 26·02 |
| „ ..... | Charleroi ..... | 3,597,700 | 25·12 |
| „ ..... | Centre ..... | 3,160,000 | 22·05 |
| Namur..... | Namur ..... | 474,975 | 3·31 |
| Liége ..... | Liége..... | 3,367,943 | 23·50 |
| | Total..... | 14,329,578 | 100·00 |

In 1875 the output had increased to 15,011,331 metric tons; in 1876 a decrease of 681,753 metric tons (4·54 per cent) is shown, in which the several provinces share at the following rates: Hainault, 481,515 metric tons, or 4·39 per cent; Liége, 183,848 metric tons, or 5·18 per cent; Namur, 16·390 metric tons, or 3·33 per cent.

The fluctuations in the output of coal since 1830, when Belgium was separated from Holland, are shown by the following table. It will be observed that the production of this small but highly industrious country was, in spite of the general crisis, larger in 1876 than at the time immediately preceding the general rise of 1872.

| Year. | Production of Coal in Metric Tons. | | | | | Value in £ Sterling. |
|---|---|---|---|---|---|---|
| | Hainault. | Liége. | Namur. | Luxemburg | Belgium. | |
| 1830..... | 1,913,677 | 432,120 | ... | ... | ... | ... |
| 1835..... | 1,965,166 | 591,931 | ... | ... | ... | ... |
| 1840..... | 2,951,781 | 853,123 | 125,054 | 4 | 3,929,962 | 1,851 |
| 1845..... | 3,670,486 | 1,086,045 | 161,872 | 753 | 4,919,156 | 1,884 |
| 1850..... | 4,420,761 | 1,222,225 | 177,602 | 296 | 5,820,884 | 1,857 |
| 1855..... | 6,458,416 | 1,720,053 | 230,861 | ... | 8,409,330 | 4,157 |
| 1860..... | 7,506,720 | 1,898,647 | 204,528 | ... | 9,609,895 | 4,280 |
| 1865..... | 9,206,058 | 2,328,911 | 305,734 | ... | 11,840,703 | 4,950 |
| 1866..... | 9,851,424 | 2,564,551 | 358,687 | ... | 12,774,662 | 6,034 |
| 1867..... | 9,595,280 | 2,770,956 | 389,586 | ... | 12,755,822 | 6,322 |
| 1868..... | 9,398,550 | 2,589,070 | 310,969 | ... | 12,298,589 | 5,348 |
| 1869..... | 9,840,530 | 2,799,826 | 303,638 | ... | 12,943,994 | 5,438 |
| 1870..... | 10,196,530 | 3,162,181 | 338,407 | ... | 13,697,118 | 5,938 |
| 1871..... | 10,037,230 | 3,345,557 | 350,389 | ... | 13,733,176 | 6,145 |
| 1872..... | 11,616,166 | 3,653,094 | 389,688 | ... | 15,658,948 | 8,332 |
| 1873..... | 11,652,953 | 3,674,578 | 450,870 | ... | 15,778,401 | 13,489 |
| 1874..... | 10,698,130 | 3,530,775 | 440,124 | ... | 14,669,029 | 9,625 |
| 1875..... | 10,968,175 | 3,551,791 | 491,365 | ... | 15,011,331 | 9,182 |
| 1876..... | 10,486,660 | 3,367,943 | 474,975 | ... | 14,329,578 | 7,755 |

There are 12 manufactories of *artificial fuel* (*briquets*), of which we enumerate the following: That of the *Grand-Bouillon du Bois de Saint Ghislain* Colliery in the Mons district, those of *Messrs. Dehaynin & Co.* and of the *Société anonyme d'Agglomérés de Houille* at Châtelinau in the Charleroi district, and one which has lately been started in the Liége district by the *Hasard* Coal Company.

We estimate the production of artificial fuel in Belgium at 1,000 metric tons per working day, without however taking into account the smaller works which are supplying the demand for domestic purposes.

The length of *railways* open in Belgium was 3,589 kilometres in 1876 against 2,897 kilometres in 1870, the increase of the six years being 692 kilometres.

The *navigable rivers* of the kingdom have a total length of 1,000 kilometres, and the *canals* 899 kilometres. As the latter were 449 kilometres in 1830, their length has been doubled since. The other important improvements necessitated by the increase of the water traffic, by which almost all waterways were deepened to 1·60 metres at least, cannot be described here.

An exception to the flourishing state of the other means of conveyance is that of the Belgian merchant fleet, which is decreasing. In 1875 it consisted of 59 vessels of 50,186 metric tons, and in 1876 it declined to 48 vessels of 44,980 metric tons—the decrease of the number accordingly being 19 per cent, and that of the tonnage 10 per cent.

The state of the merchant fleet in 1860, 1870, and 1876 is shown in the following table:—

| | Steamers. | | | Sailing Vessels. | | |
|---|---|---|---|---|---|---|
| | 1860. | 1870. | 1876. | 1860. | 1870. | 1876. |
| Number of Vessels | 8 | 12 | 23 | 108 | 55 | 25 |
| Tonnage | 4,254 | 9,501 | 29,850 | 28,857 | 20,648 | 15,130 |

Of the 48 vessels in 1876—

| | | | | | |
|---|---|---|---|---|---|
| 38 | were owned | in | Antwerp, | of | 39,375 tons. |
| 5 | „ | „ | Ostend, | „ | 4,732 „ |
| 3 | „ | „ | Ghent, | „ | 555 „ |
| 2 | „ | „ | Brussels, | „ | 318 „ |
| Total..... 48 | | | | | 44,980 tons. |

The influence of the Belgian merchant fleet on the coal trade is insignificant, as the quantity exported by sea in 1876 was hardly more than 20,000 metric tons. Nearly the entire production (as stated before) is carried to the places of consumption by the means of inland communication—the railways and canals.*

The district in which the output of Belgian coal is consumed may be defined as follows: Nearly three-sixths of the whole is consumed by the iron, glass, and other works situated within an imaginary boundary extending 25 kilometres along the axial line of the coalfield. The remainder is carried beyond this district, about one-sixth being consumed in Belgium and two-sixths in foreign parts.

The boundaries of the Belgian coal market have, however, been considerably narrowed within the last five years. In the north and east, where they had extended far beyond the frontiers in consequence of the Franco-German war in 1870-1871, they have been forced back into the interior of the country by English and German competition. Large quantities of foreign coal are sold at Ghent, Antwerp, Brussels, and for special purposes even within the boundaries of the Belgian coalfield itself.

German coke has made considerable progress in the south-east. The Saar district has recovered a part of the Alsace-Lorraine market, and, owing to cheap rates of transit freight, the Ruhr district is able to supply a great portion of the considerable demand of the Luxemburg blast-furnaces.

* Carte de la Production, de la Circulation et de la Consommation des Charbons Belges en 1873. Elaborée par MAX GOEBEL, à Liége.

Lastly, towards the south the French market is severely contested—the sea-coast, the Seine district, and Paris by English, and the eastern and northern départements by German competition.

It may be assumed that Belgian coal is at present not carried beyond the following boundaries: to the north, the Dutch frontier; to the east, the Maas, as far as Mastricht; the German frontier, as far as Gouvy (on the Luxemburg frontier), and the Alsace-Lorraine railway, from Luxemburg *vid* Metz to Frouard; to the south, the Frouard-Bar-le-Duc railway line (St. Dizier included); from there along the downward course of the Marne to Châlons, Epernay, Château-Thierry and Paris; lastly, along the course of the Seine down to Rouen; to the west, a line drawn from Rouen by Amiens, Arras, Bethune, Hazebrouck, to Dunkirk. The northern sea-coast is exclusively supplied from England. But, as we said before, competition is carried on even within these boundaries, which may be attributed to the circumstance that the latter include also the important French coal districts of the Départements du Nord and Pas-de-Calais. Besides this, an advantage accrues to the collieries of these districts from the duty of 1·20 francs per ton of foreign coal imported into France, the Belgian market being at the same time not only open to anyone, but even made easily accessible on the part of the Government by cheap railway tariffs.

The price of coal at the pit's mouth in January, 1878, was in the different districts:—

| | Caking and Flaming Coal. | | | | | |
|---|---|---|---|---|---|---|
| | Slack, per ton. | Smiths' Coal, per ton. | Rough Coal, per ton. | Round Coal, per ton. | Cops, per ton. | Coke, per ton. |
| | s. d. | s. d. | s. d. | s. d. | s. d. | s. d. |
| Mons | 8 0 | 9 7 | 11 2 | 18 5 | 20 0 | 11 9 |
| Charleroi | 7 2 | 8 10 | 10 5 | 17 7 | 19 2 | 11 7 |
| Centre | 7 2 | 8 10 | 11 2 | 17 7 | 19 2 | 11 9 |
| Liége | 6 5 | 8 0 | 9 7 | 16 9 | 18 5 | 11 2 |
| Namur | .... | ... | .... | .... | .... | .... |
| | Close-Burning Coal. | | | | | |
| | s. d. | s. d. | s. d. | s. d. | s. d. | s. d. |
| Mons | .... | .... | .... | .... | .... | .... |
| Charleroi | 7 2 | 8 10 | 10 5 | 16 9 | 18 5 | .... |
| Centre | 7 2 | 8 10 | 11 2 | 16 9 | 18 5 | .... |
| Liége | 6 5 | 8 0 | 9 7 | 16 9 | 18 5 | .... |
| Namur | .... | .... | .... | .... | .... | .... |
| | Open-Burning Coal. | | | | | |
| | s. d. | s. d. | s. d. | s. d. | s. d. | s. d. |
| Mons | 5 7 | 7 2 | 8 10 | 14 5 | 15 2 | .... |
| Charleroi | 5 2 | 6 5 | 8 5 | 13 7 | 15 2 | .... |
| Centre | .... | .... | .... | .... | .... | .... |
| Liége | 4 10 | 6 5 | 8 0 | 13 7 | 15 2 | .... |
| Namur | 3 2 | 4 10 | 6 5 | 11 9 | 13 7 | .... |

In many cases these general prices are only nominal, as the collieries frequently allow reductions.

The competition in round coal is especially severe; that of the Ruhr district being at present able to contest all the markets before named. Screened flaming coal is sold at present by the Ruhr collieries at 8s. 5d. to 9s. 7d. per ton, and as it is carried at 5s. 2d. to 8s. per ton to the places of consumption it would be sent into the country in larger quantities than at present, and even to Antwerp for shipment, if it did not crumble to pieces as easily as it does.

From the following table it will be seen to what extent the import of coal into Belgium has increased, and the export decreased, since 1872:—

| Year. | Import. | | | | Export. | | | |
|---|---|---|---|---|---|---|---|---|
| | Quantity. | | Value. | | Quantity. | | Value. | |
| | Coal. | Coke. | Coal. | Coke. | Coal. | Coke. | Coal. | Coke. |
| | Metric Tons. | | £ Sterling. | | Metric Tons. | | £ Sterling. | |
| 1840 | 21,148 | | 12,665 | | 779,000 | | 467,093 | |
| 1850 | 9,397 | | 5,624 | | 1,987,000 | | 1,190,861 | |
| 1860 | 97,009 | | 62,005 | | 3,450,000 | | 2,205,488 | |
| 1866 | 179,427 | 4,819 | 114,719 | 5,183 | 3,971,772 | 547,504 | 2,538,839 | 590,614 |
| 1867 | 421,219 | 22,880 | 269,292 | 21,956 | 3,564,308 | 516,898 | 2,278,398 | 495,650 |
| 1868 | 247,749 | 4,891 | 148,460 | 4,254 | 3,754,645 | 539,965 | 2,250,086 | 474,575 |
| 1869 | 214,339 | 9,124 | 128,460 | 8,019 | 3,581,235 | 687,584 | 2,146,123 | 604,355 |
| 1870 | 220,656 | 8,108 | 132,226 | 7,090 | 3,175,828 | 576,501 | 1,898,249 | 506,702 |
| 1871 | 200,789 | 3,193 | 120,343 | 3,080 | 3,678,024 | 598,180 | 2,204,118 | 487,240 |
| 1872 | 210,829 | 8,041 | 155,795 | 8,998 | 4,608,016 | 749,072 | 3,405,757 | 789,050 |
| 1873 | 671,836 | 24,312 | 711,299 | 42,739 | 4,157,903 | 801,820 | 4,401,978 | 1,409,494 |
| 1874 | 454,869 | 8,790 | 381,616 | 10,171 | 3,902,385 | 599,020 | 3,274,002 | 694,038 |
| 1875 | 704,178 | 20,262 | 562,692 | 22,641 | 4,063,960 | 645,787 | 3,247,253 | 722,400 |
| 1876 | 805,580 | 26,716 | 579,269 | 27,775 | 3,828,482 | 571,123 | 2,753,168 | 593,255 |

The import and export of 1875 and 1876 have to be distributed as follows :—

| Countries. | Import. | | | | | |
|---|---|---|---|---|---|---|
| | 1875. | | | 1876. | | |
| | Coal. | Coke. | Total.* | Coal. | Coke. | Total.* |
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. |
| Prussia | 214,707 | 13,142 | 235,481 | 280,913 | 20,015 | 309,506 |
| Holland† | 1,266 | 222 | 1,583 | 1,260 | 36 | 1,311 |
| England | 402,731 | 913 | 404,035 | 432,570 | 1,251 | 434,857 |
| France | 85,444 | 5,985 | 93,994 | 90,827 | 5,414 | 98,561 |
| Other Countries | 30 | .. | 30 | 10 | .. | 10 |
| Total | 704,178 | 26,262 | 733,123 | 805,580 | 26,716 | 843,745 |
| Value in £ sterling | 562,657 | 22,666 | 585,322 | 579,311 | 27,751 | 607,062 |

| Countries. | Export. | | | | | |
|---|---|---|---|---|---|---|
| | 1875. | | | 1876. | | |
| | Coal. | Coke. | Total.* | Coal. | Coke. | Total.* |
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. |
| France | 3,889,254 | 307,399 | 4,328,395 | 3,676,336 | 327,967 | 4,144,860 |
| Holland | 130,990 | 4,025 | 136,740 | 109,256 | 4,535 | 115,735 |
| Zollverein (Prussia, &c. and Luxemburg) | 41,171 | 384,363 | 518,832 | 8,435<br>29,945 | 33,328<br>204,108 | 56,016<br>321,528 |
| Chile and Brazil | 1,365 | .. | 1,365 | .. | .. | .. |
| England | 10 | .. | 10 | .. | .. | .. |
| Spain and Portugal | 435 | .. | 435 | 240 | 920 | 1,554 |
| Other Countries | 735 | .. | 735 | 4,270 | 265 | 4,648 |
| Total | 4,063,960 | 645,787 | 4,986,512 | 3,828,482 | 571,123 | 4,644,371 |
| Value in £ sterling | 3,247,210 | 722,401 | 3,969,610 | 2,753,151 | 593,245 | 3,346,396 |

The foregoing tables refer exclusively to the fuel consumed or raised in Belgium.

The quantity of foreign coal passing through Belgium, by way of transit, amounted in 1876 to 101,583 metric tons of coal and 189,104 metric tons of coke,

* In summing up for the third column of each year 100 tons of coal have been substituted for each 70 tons of coke.

† Nearly the whole quantity imported from Holland is either German or English coal.

which were almost entirely of German origin, and came from the following countries :—

| Countries. | Coal. | Coke. | Total. |
|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. |
| Prussia | 406 | 170 | 649 |
| Luxemburg | 16,680 | 184,931 | 209,438 |
| Holland | 1,837 | ... | 1,837 |
| England | 645 | ... | 645 |
| France | 82,015 | 54,003 | 159,162 |
| Total | 101,583 | 189,104 | 371,731 |

For the purpose of obtaining a correct notion of the quantity of coal carried from Belgium to the different places of consumption, it is necessary to add the transit to the export figures.

The quantity of native and foreign coal which went out of Belgium in 1876, was :—

Metric Tons.

| To | Russia. | Prussia. | Luxemburg. | Holland. | England. | France. | Spain. | Malta. | Argentine Republic. | Peru. | French Antilles. | Other Countries. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coal. | 1,155 | 8,841 | 46,625 | 111,093 | 645 | 3,758,351 | 240 | 2,000 | 500 | 290 | .. | 325 |
| Coke | .. | 33,328 | 339,039 | 4,535 | .. | 381,970 | 920 | .. | .. | 40 | 225 | .. |

The small quantities going to Russia, England, Spain, Malta, the Argentine Republic, Peru, and the Antilles are of course exported by sea, and do not deserve our consideration, which is only due to the export by rail, river, and canal.

The whole quantity exported to Prussia is carried by rail *vid* Herbesthal. Of the export to Holland 90% went by Mastricht, partly on the Maas, partly by the Liége, Mastrich, and the Grand Central Belge railways ; 10% crossed the northern frontier *vid* Antwerp or Turnhout. The export to Luxemburg went partly by the Pépinster-Spa-Gouvy, and partly by the Grand Luxemburg line *vid* Steepenich ; the former way was taken principally by the large quantities of German coke for the Luxemburg market, passing through Belgium by way of transit, and other quantities of coal have been carried by both lines in the same way through Luxemburg, partly to Alsace-Lorraine, partly to eastern France. Almost the entire demand of Luxemburg for coke is supplied from the Ruhr district, coming in almost equal portions by the Pépinster-Gouvy and by the Eifel (Düren-Treves) railway lines. As has been said before, France is the best customer for Belgian coal, and it will therefore be interesting to obtain a return of the quantities exported into France during 1876 by the different routes :—

| | *Vid* Condé (Canal.) | By rail, Valenciennes. | By rail, Mons-Hautmont. | By rail, Mouscron, Lille, and Espierre Canal. | By rail, Tournai-Lille (Baisieux.) | *Vid* Jeumont (Sambre). | *Vid* Jeumont, by rail. | *Vid* Givet (Maas), and by Anor, Vireux, Givet and Athus, by rail. |
|---|---|---|---|---|---|---|---|---|
| | Metric Tons | Metric Tons | Metric Tons | Metric Tons | Metric Tons | Metric Tons | Metric Tons | Metric Tons. |
| Coal.. | 488,508 | 59,220 | 668,187 | 211,156 | 114,965 | 442,885 | 1,023,214 | 750,218 |
| Coke | 13,926 | 9,281 | 99,699 | 1,980 | 4,511 | 814 | 55,163 | 196,506 |

The figures of the last column have been obtained by calculation; the others have been taken from a statistical return made by Messrs. Bracq-Miroir, of Condé. It may be taken for granted that two-thirds of the quantity of coke returned in the last column have been exported *viâ* Athus; and that three-fourths of the quantity of coal of the same column went *viâ* Anor, Vireux, and Givet. The greatest portion of these quantities meet together near to the frontier, and find their way by rail or canal to Paris. More than 3½ million tons of the Belgian export of coal to France are supplied by the province of Hainault, one-third of this quantity being consumed in the Seine Département.

When speaking of France we had occasion to say something more on the influence exerted by Belgium upon the supply of the principal places of consumption. At present we confine ourselves to giving a summary review of production, import and export, in the following table, which will contain also the consumption on Belgian soil :—

| Year. | Import. | | | Output and Import. | Export. | | | Total Consumption and Stock of Belgian Coal. |
|---|---|---|---|---|---|---|---|---|
| | Coal. | Coke. | Total. | | Coal. | Coke. | Total. | |
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. |
| 1866 | 179,427 | 4,819 | 186,311 | 12,969,973 | 3,971,772 | 547,504 | 4,753,921 | 8,207,052 |
| 1867 | 421,219 | 22,880 | 453,905 | 13,209,727 | 3,564,308 | 516,898 | 4,302,734 | 8,906,993 |
| 1868 | 247,749 | 4,891 | 254,663 | 12,553,252 | 3,754,645 | 539,965 | 4,526,024 | 8,027,228 |
| 1869 | 214,339 | 9,124 | 227,373 | 13,171,367 | 3,581,235 | 687,584 | 4,563,498 | 8,607,869 |
| 1870 | 220,656 | 8,108 | 232,239 | 13,929,357 | 3,175,828 | 576,501 | 3,999,403 | 9,929,956 |
| 1871 | 200,769 | 3,193 | 205,350 | 13,938,526 | 3,678,024 | 508,180 | 4,403,995 | 9,534,531 |
| 1872 | 210,829 | 8,043 | 222,316 | 15,881,264 | 4,608,016 | 749,072 | 5,678,119 | 10,203,145 |
| 1873 | 671,836 | 24,312 | 706,567 | 16,484,368 | 4,157,903 | 801,820 | 5,303,360 | 11,181,608 |
| 1874 | 454,869 | 8,790 | 467,420 | 15,136,449 | 3,902,385 | 599,020 | 4,758,127 | 10,378,322 |
| 1875 | 704,518 | 20,262 | 733,123 | 15,744,454 | 4,063,960 | 645 787 | 4,986,512 | 10,757,942 |
| 1876 | 805,580 | 26,716 | 843,745 | 15,173,323 | 3,828,482 | 571,123 | 4,644,371 | 10,528,952 |

The increase of the stock of coal during 1876 is valued by M. LAGUESSE, engineer and manager of the Hainault Collieries, at 183,272 metric tons. The consumption in Belgium may accordingly be set down at 10,345,680 metric tons, of which 92 per cent were supplied by the country itself and 8 per cent by foreign parts. The greater portion of this enormous quantity, amounting to 1,915 kilogrammes per head for 5,403,006 inhabitants (return of 1875), has, as a matter of course, been consumed for industrial purposes.

The following is a statistical return of the steam engines in Belgium :—

| | According to the returns of the year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1850 | 1860 | 1870 | 1871 | 1872 | 1873 | 1874 | 1875 | 1876 |
| Steam Engines { No. | 2,250 | 4,961 | 9,294 | 9,749 | 10,275 | 11,088 | 11,690 | 12,241 | 12,636 |
| Steam Engines { Horse-power. | 54,300 | 157,177 | 338,404 | 365,167 | 394,024 | 445,133 | 504,277 | 510,027 | 539,864 |
| Boilers Working ..... | 3,018 | 5,542 | 9,879 | 10,060 | 10,468 | 11,020 | 11,356 | 13,264 | 13,636 |
| Single Boilers .....No. | 105 | 260 | 439 | 439 | 431 | 436 | 454 | 506 | 578 |

Everyone who has attentively perused the figures previously given will observe that the inland consumption in Belgium is increasing at the cost of the export. This fact is absolutely proved by the Belgian mining statistics. If we take into account the figures given prior to the last ten years, without considering the exceptional amount of business during 1872 to 1874, we find that the export of 1876 is smaller than that of 1866, the output and the inland consumption having increased during the same time by 1½ million and 2 million tons respectively. It has been stated above that the consumption per head of population in 1876 had been 1,915 kilogrammes. If the entire output was to be consumed within the country this figure would be increased to 2,652 kilogrammes, which is not at all beyond the bounds of possibility, seeing that in Great Britain and Ireland the consumption per head was 3,300 kilogrammes as early as 1865.

Looking at the difficulties by which coalmining in Belgium is more and more beset, we may reasonably expect that the time is not far distant when Belgian coal will be exported only in the shape of manufactured goods.

## IRON.

The iron ores mined in Belgium are specular ore, bog ore, and clay ironstone. Specular ore is found, together with other minerals, in deposits of different geological structure. In Belgium it occurs only in the shape of incrustations of cavities.

Several small deposits of this description are found near Famenne, in the quartzose schists of Dumont; they are cropping out at both sides of the coal-field in the provinces of Namur and Liége, which has been described above. Their northern outcrop begins at Isnes-les-Dames, extends eastwards by Rhisne, Emines, Marchovelette, and Vezin, and turns abruptly south-west towards Marche-les-Dames, where it ends. To the east from Vezin the lode is interrupted by faults, and only reappears near Couthuin, in the province of Liége, for a few kilometres in length. Towards the south it appears on the right bank of the Sambre, at a short distance southwards of Floreffe; from thence it turns towards the east, and extends southwards of Malonne towards Wepion-on-the-Maas, and southwards of Wierde towards Haltinnes, Huy, Ampsin, Amay, and Engis, where it ends.

Specular ore is also found at other places of the province of Liége, near Chaudfontaine, between Verviers and Dolhain, and near Goé—these deposits however being of small extent only.

The most important workings are carried on in the northern branch of the lode. Near Vedrin four bands of this ore are known, 0·07, 0·10, 0·20, and 0·30 metres thick, having, together with the interposed layers of schists, an aggregate thickness of 1·20 metres.

The workings along the southern outcrop of the lode are of less importance. The most noteworthy deposits have been opened near Huy, below the Chaumont forests, where a bed of 1·08 metres thickness has been found, consisting of two bands of ore separated by a schistose stratum 0·25 metres thick.

These specular ores yield from 35 to 44 per cent of cold short iron.

Clay ironstone is found, together with bog ore, in agglomerations and isolated seams, of which we shall have to speak afterwards. It is mined in Belgium in small quantities only.

Bog ores are found in the most varying geological formations. In the Campine district seams of them, 0·15 to 1 metre thick, are found in the argillaceous sands of the lower portions of the plain, chiefly on the banks of the rivers Demer and Nethe and their tributaries. The ores of these seams are stalactite-like, porous, of a sparkling and shining surface of fracture, and yield about 40 per cent of iron. They contain much phosphorus, but are easily reduced in the blast-furnace.

Near Quevy, in the province of Hainault, bog ores containing phosphorus and silica, intermixed with argillaceous sand, and belonging to the post-tertiary formation, are found, in a bed of 1 to 1·50 metres thickness. The isolated deposits of alluvial ore which, in the province of Luxemburg, near Ruette, Athus, Toernich, &c., are overlying the Jurassic limestones, are also a part of the same formation. They contain 30 to 45 per cent of iron, and are easily reduced in the blast-furnace; their iron is either cold or red short.

The tertiary and Lias formations of the Campine district, near the river Scheldt, contain several bog-ore deposits, which at present are actually being worked at Groenendael and in the calcareous formations near Tournay.

Enormous quantities of ores are raised by the Belgian iron trade as well as by the French, German, and Luxemburg ironmasters, from the Jurassic limestone, extending all over the southern portion of the Belgian province and the Grand Duchy of Luxemburg, as well as over the northern portion of Lorraine.

The calcareous oolithic ore (minette) of these parts is a bog ore composed of small rounded particles, like the roe of a fish, of one-third to one-sixth millimetre diameter and of a reddish or grey colour, containing 30 to 45 per cent of iron. The gangue consists of carbonate of lime, silica, and a small quantity of gypsum, and is highly fusible. Large deposits of this ore are found in the lower strata of the Jurassic formation—exceptionally large are those of the southern portions of the Grand Duchy and those of Lorraine. In Belgium the minette is only found on a limited area southward of the villages of Musson and Halanzy, near to the French frontier, in a seam of 1·50 to 2 metres thickness.

Lastly, numerous and important deposits of bog ores are contained in a portion of the metamorphic system, interposed between the lower quartzose schists and the coal measures. They always occur in the shape of agglomerations and isolated masses, never as regular beds, and the greatest portion of the ores consumed by the Belgian iron trade has hitherto been obtained from them. They are found along the line of separation of the calcareous and slaty strata occurring in the greywacke, or at a short distance from it, and in consequence of numerous folds in these strata they are cropping out at many places between the Sambre and the Maas and between the Sambre and the Ardennes. Between these strata the ores are found in veins, varying in thickness from a few centimetres up to 15 to 20 metres and more. These deposits are found in the provinces of Namur, Liége, Hainault, and Luxemburg, but it is only in the first named two that the output is of importance. These bog ores are of a yellow or brown colour, of vesicular or compact texture, and intermixed with other minerals, as pyrites, clay, sand, &c.

It will be seen from the following table that the output of ores in Belgium has fallen off during the last years. This decline is explained by the steady increase of the import of Luxemburg minette ore. Eighteen years ago almost three-fourths of the ores used in Belgium were raised in the province of Namur. It will be seen from the import column of our table how enormous has been the change in that respect :—

| Year. | Iron Ores. | | | | | |
|---|---|---|---|---|---|---|
| | Output. | | Import. | | Export. | |
| | Quantity. | Value. | Quantity. | Value. | Quantity. | Value. |
| | Metric Tons. | £ | Metric Tons. | £ | Metric Tons. | £ |
| 1850 | 367,360 | 107,149 | ... | ... | ... | ... |
| 1860 | 809,176 | 309,568 | 1,486 | 1,600 | 152,114 | 131,480 |
| 1865 | 1,018,231 | 392,702 | 801,846 | 723,558 | 230,539 | 221,041 |
| 1867 | 603,829 | 227,841 | 822,891 | 848,295 | 152,227 | 109,866 |
| 1868 | 519,740 | 189,802 | 896,282 | 427,479 | 136,067 | 97,841 |
| 1869 | 628,046 | 228,080 | 551,900 | 595,314 | 164,576 | 98,640 |
| 1870 | 654,332 | 231,935 | 568,571 | 613,292 | 179,867 | 107,789 |
| 1871 | 697,272 | 252,799 | 594,405 | 641,178 | 162,566 | 97,401 |
| 1872 | 749,781 | 294,258 | 790,593 | 852,800 | 178,997 | 121,577 |
| 1873 | 503,565 | 240,598 | 739,541 | 797,748 | 215,042 | 146,062 |
| 1874 | 527,050 | 206,715 | 788,835 | 590,360 | 109,144 | 61,046 |
| 1875 | 365,044 | 136,758 | 804,370 | 642,697 | 141,767 | 79,303 |
| 1876 | 269,206 | 98,200 | 671,134 | 536,266 | 166,418 | 93,087 |

The present state of affairs, which threatens to dislocate the Belgian production of pig-iron, is sufficiently evident from the foregoing table. It is the consequence of defective mining legislation, which has neglected to provide regulations of the ore-beds below the surface of the ground, and consequently has not enforced the adoption of rational methods for their utilisation.

The following table gives some special returns concerning the quantities of

ores imported and exported, and the countries from or to which they were sent. The large quantities sent from the Grand Duchy, the Belgian export to France, and the rapid increase of the import of Spanish and Algerian ores will at once be apparent :—

| Import of Iron Ores | | | | Export of Iron Ores | | | |
|---|---|---|---|---|---|---|---|
| From | 1877. | 1876. | 1875. | To | 1877. | 1876. | 1875. |
| | Metric Tons. | Metric Tons. | Metric Tons. | | Metric Tons. | Metric Tons. | Metric Tons. |
| Prussia | 59,106 | 46,154 | 88,690 | Prussia | 10,682 | 14,641 | 3,585 |
| Grand Duchy of Luxemburg | 573,600 | 515,568 | 581,836 | Holland | 192 | 4,099 | 1,212 |
| Holland | 10,334 | 3,136 | 17,285 | France | 204,338 | 147,236 | 136,894 |
| France | 63,996 | 70,836 | 98,561 | Other Countries. | 446 | 440 | 75 |
| Spain | 55,374 | 24,719 | 9,780 | | | | |
| Algeria | 16,229 | 8,375 | 7,894 | | | | |
| Other Countries | 4,657 | 2,343 | 321 | | | | |
| Total | 783,296 | 671,131 | 804,367 | Total | 215,658 | 166,416 | 141,766 |

As early as the times of the Romans the inhabitants of the Belgian provinces were noted for their skill and industry. They were proficient in the art of mining and working ores. Two old furnaces, dating from this time, were discovered in 1870, at Lustin, between Namur and Dinant, and we are able to obtain a correct notion of the iron manufacturing process of that age from their construction. In the 12th century the manufacture of iron was in a state of comparatively great perfection in the Netherlands; and in 1560 there were no less than 35 smelting furnaces and 85 forges existing there. About the year 1800 furnaces of a circular section were introduced, instead of the octagonal ones that had been in use. The height was increased from 4·5 to 7·5 metres, and the daily production rose to three metric tons, which at the time was considered an extraordinary figure.

The first coke blast-furnace on the Continent was put up in 1826, at the works erected by JOHN COCKERILL at Seraing in 1817. In 1830 four coke and eleven charcoal furnaces (three of the latter being in blast) existed in the province of Hainault. The province of Namur numbered forty charcoal and one coke furnace, with a total production of 25,000 metric tons. Lastly, the province of Luxemburg, including at that time the Grand Duchy, had 21 furnaces, producing a total of 9,200 metric tons. A single coke furnace produced about 2,000 tons of pig-iron, from a quantity of fuel and ores worth something like £10,467.

The following table shows the increase of the production of pig-iron in Belgium from 1840 :—

Pig-Iron.

| Year. | Production. | | Number of Furnaces in Blast. | Import. | | Export. | |
|---|---|---|---|---|---|---|---|
| | Quantity. | Value. | | Quantity. | Value. | Quantity. | Value. |
| | Metric Tons. | £ Sterling. | | Metric Tons. | £ Sterling. | Metric Tons. | £ Sterling. |
| 1840 | .. | .. | .. | .. | 5,953 | 10,438 | 60,486 |
| 1850 | 144,452 | 462,191 | 41 | .. | 8,510 | 92,345 | 534,948 |
| 1860 | 319,943 | 1,050,295 | 51 | 725 | 2,477 | 22,086 | 74,989 |
| 1865 | 470,767 | 1,479,172 | 56 | 24,864 | 80,462 | 10,711 | 34,678 |
| 1867 | 423,069 | 1,265,869 | .. | 53,385 | 170,632 | 11,062 | 35,857 |
| 1868 | 435,754 | 1,225,244 | .. | 42,549 | 135,994 | 16,525 | 52,816 |
| 1869 | 534,319 | 1,499,912 | .. | 61,600 | 196,880 | 14,266 | 45,584 |
| 1870 | 565,234 | 1,646,346 | 48 | 82,330 | 263,119 | 10,176 | 32,520 |
| 1871 | 609,230 | 1,792,368 | 49 | 84,299 | 269,432 | 48,526 | 155,091 |
| 1872 | 655,565 | 2,613,637 | 52 | 137,008 | 574,739 | 49,096 | 205,949 |
| 1873 | 607,373 | 2,806,509 | 54 | 145,212 | 754,201 | 27,208 | 141,308 |
| 1874 | 532,790 | 1,897,777 | 55 | 158,291 | 695,632 | 16,188 | 71,153 |
| 1875 | 540,473 | 1,629,044 | 42 | 146,886 | 645,583 | 15,672 | 68,876 |
| 1876 | 490,508 | 1,323,661 | 31 | 207,264 | 910,850 | 9,479 | 41,669 |

The entire production of the Belgian blast-furnaces during 1877 was contributed as follows: In the Liége district there were 8 furnaces out of blast and 11 at work, viz., 15 furnaces making 106,000 metric tons of foundry and forge pig and 6 making 75,800 metric tons of Bessemer pig-iron. In the Charleroi district—all furnaces of the centre district and one of the province of Namur included—we find of a total number of 40 furnaces only 13 in blast, 11 of which made 160,000 metric tons of pig-iron and 2 produced 27,600 metric tons of castings. The remaining 27 furnaces of this district were out of blast. In the Athus district there were 2 furnaces, one of them producing 36,600 metric tons of forge pig and the other 21,600 metric tons of castings. Of the whole number of 61 furnaces built in Belgium only 26 were in blast.

The production of these 26 furnaces may be classified as follows:—

| | | | | | |
|---|---|---|---|---|---|
| 17 | furnaces | produced | 300,200 | metric tons | of foundry and forge pig. |
| 6 | „ | „ | 75,800 | „ | Bessemer pig. |
| 3 | „ | „ | 49,200 | „ | castings. |

Total of 26 furnaces produced 425,200 metric tons.

From the following tabular statement of the import of foreign pig-iron into Belgium and the export of Belgian pig-iron it will appear that England has the largest share of the former; but this might probably soon be changed by the rapid increase of the production of Bessemer pig-iron in Belgium, which for the greatest part has hitherto been purchased from England:—

| Import of Pig-iron | | | | Export of Pig-iron | | | |
|---|---|---|---|---|---|---|---|
| From | 1877. Metric Tons. | 1876. Metric Tons. | 1875. Metric Tons. | To | 1877. Metric Tons. | 1876. Metric Tons. | 1875. Metric Tons. |
| Sweden and Norway .. | 1,094 | 1,915 | 1,834 | Grand Duchy of Luxemburg ..... | 50 | 691 | 1,380 |
| Prussia ..... | 35,535 | 27,686 | 18,452 | Hamburg ..... | .... | 135 | 140 |
| Grand Duchy of Luxemburg ..... | 59,840 | 78,389 | 45,880 | Holland ..... | 1,015 | 305 | 500 |
| Holland ..... | 14,634 | 10,525 | 5,464 | England ..... | 1,024 | 799 | 78 |
| England ..... | 81,313 | 88,050 | 74,778 | France ..... | 7,739 | 5,464 | 8,150 |
| Other Countries..... | 962 | 695 | 475 | Switzerland ..... | 1,451 | 730 | 688 |
| | | | | United States ..... | 110 | 134 | 266 |
| | | | | Brazil ..... | 13 | 105 | .... |
| | | | | Other Countries ..... | 621 | 1,113 | 4,467 |
| otal ..... | 193,378 | 207,260 | 146,883 | Total ..... | 12,023 | 9,476 | 15,669 |

In 1876 the imports exceeded the exports by 197,784 metric tons, and as the production of the same year amounted to 490,508 metric tons the home consumption of pig-iron may be fixed at 688,292 metric tons. In 1875 a quantity of 671,687 metric tons was left for the home demand, the production being much larger, but the import much smaller than in 1876.

The difference between the home demand in 1875 and that in 1876 is but small, and may be explained by the circumstance that the decrease in the home production was retrieved by an equal import from foreign parts. In 1877 the quantity left for the home demand declined to 606,553 metric tons; but this decrease is only to be attributed to the home production.

The following is a tabular statement of the appliances for manufacturing wrought-iron in Belgium; it indicates besides the distribution of this manufacture among the different provinces. We select the figures of 1875 as the most complete, and corresponding to a normal state of business:—

Forges and Rolling Mills.

| Object. | Brabant. | Hainault. | Namur. | Liége. | Belgium. Total. | Notes. |
|---|---|---|---|---|---|---|
| Number of Works | 2 | *30 | 5 | 17 | 54 | * Of these 3 out of Work. |
| ,, Open Fires (charcoal) | .. | .. | 7 | .. | 7 | |
| ,, Puddling Furnaces | 85 | †507 | 54 | 259 | 676 | † Of these 179 out of Work. |
| ,, Heating ,, | 12 | ‡199 | 21 | 142 | 289 | ‡ Of these 35 out of Work. |
| ,, Squeezers, &c. | 2 | 21 | .. | 6 | 29 | |
| ,, Helves and Steam-hammers | 5 | 53 | 11 | 42 | 111 | |
| ,, Tilt-hammers | 2 | 7 | .. | 2 | 11 | |
| ,, Shears and Saws | 11 | 133 | 2 | 75 | 221 | |
| ,, Cogging Mills | 4 | 37 | 1 | 26 | 68 | |
| ,, Merchant ,, | 2 | 29 | .. | 11 | 42 | |
| ,, Guide ,, | 3 | 33 | 1 | 13 | 50 | |
| ,, Rail ,, | .. | 8 | 2 | 4 | 14 | |
| ,, Plate & Sheet ,, | 3 | 11 | .. | 28 | 42 | |
| ,, Slitting ,, | .. | 11 | .. | 1 | 12 | |
| ,, Steam Engines | 19 | 332 | 18 | 223 | 592 | |
| ,, Steam Horse-power | 567 | 10,051 | 550 | 5,236 | 16,404 | |
| ,, Water Wheels | 1 | 3 | 8 | 9 | 21 | |
| ,, Water Horse-power | 15 | 115 | 76 | 300 | 506 | |
| ,, Workmen | 1,048 | 7,660 | 994 | 4,449 | 14,151 | |
| Production of Wrought-Iron, &c., in Metric Tons | 21,160 | 250,373 | 39,456 | 125,451 | 436,440 | |
| Value of the same in £ sterling | 181,879 | 2,020,721 | 287,008 | 1,101,963 | 3,591,070 | |

The production of the ironworks declined considerably in 1876, the returns of that year being lower than all the years previous to 1868.

The fluctuations of the iron market before and after the unsettled state culminating in 1873 will be seen from the following table :—

Wrought-iron, Bar-iron, Blooms, Plates, Rails, &c.

| Year. | Production. | | Import. | | Export. | |
|---|---|---|---|---|---|---|
| | Quantity. Metric Tons. | Value in £ Sterling. | Quantity. Metric Tons. | Value in £ Sterling. | Quantity. Metric Tons. | Value in £ Sterling. |
| 1850 | 61,970 | 473,369 | ... | ... | ... | ... |
| 1860 | 200,596 | 1,512,539 | ... | ... | ... | ... |
| 1866 | 368,452 | 2,672,043 | ... | ... | ... | ... |
| 1867 | 340,741 | 2,384,852 | ... | ... | ... | ... |
| 1868 | 338,295 | 2,237,735 | 3,517 | 31,681 | 156,307 | 1,040,731 |
| 1869 | 468,565 | 3,148,495 | 5,806 | 49,220 | 240,386 | 1,579,754 |
| 1870 | 491,563 | 3,426,957 | 5,518 | 48,021 | 219,727 | 1,446,637 |
| 1871 | 467,216 | 3,365,685 | 4,673 | 44,346 | 186,922 | 1,410,880 |
| 1872 | 502,577 | 4,973,192 | 14,989 | 172,909 | 210,043 | 2,084,499 |
| 1873 | 480,374 | 5,566,217 | 18,177 | 249,536 | 181,661 | 2,263,521 |
| 1874 | 510,920 | 4,794,953 | 20,611 | 229,360 | 227,450 | 2,411,181 |
| 1875 | 436,440 | 3,591,070 | 9,671 | 125,048 | 182,668 | 1,972,555 |
| 1876 | 399,138 | 2,851,270 | 8,887 | 142,786 | 166,161 | 1,809,354 |

We may here give some additional returns of a most important branch of the iron industry, which is not comprised in the above table, viz., the manufacture of chains, cables, anchors, nails, &c. The number of works engaged in this branch of the trade was 61 in 1875. Their motive power consisted of 41 steam engines of 584 horse-power, and of 91 water wheels of 1,301 horse-power in the aggregate. The number of hands was 1,026; their production was 20,440 metric tons, of a total value of £308,617.

The necessary information concerning the foreign trade in the manufactured goods just mentioned will be given later on in a table containing the import and export of each separate description of hardware, &c. It may be mentioned now that the year 1871 was the busiest in this branch, the production of hardware, &c. attaining the amount of 33,143 metric tons of a value of £473,543, and that it has been steadily declining ever since. The whole of the above-mentioned production of 1875 has been exported—at least according to the official returns—and the home demand had to be supplied by imported goods.

The importance of the ironfounding trade in Belgium is proved by the following table. The export of castings, however, is inconsiderable, if the imported quantity is deducted. It may be supposed from this that as an exception to the other branches of the iron trade the production of the ironfoundries has been on the increase up to the end of the year 1875, and that nearly the whole of it has been disposed of within the country :—

| Year. | Castings. | | | | | |
|---|---|---|---|---|---|---|
| | Production. | | Import. | | Export. | |
| | Quantity. | Value. | Quantity. | Value. | Quantity. | Value. |
| | Metric Tons. | £ | Metric Tons. | £ | Metric Tons. | £ |
| 1857 | 17,016 | 122,082 | ... | ... | ... | ... |
| 1860 | 53,372 | 418,622 | ... | ... | ... | ... |
| 1866 | 72,708 | 535,040 | ... | ... | ... | ... |
| 1867 | 66,257 | 491,283 | ... | ... | ... | ... |
| 1868 | 55,504 | 413,617 | 537 | 4,275 | 1,874 | 14,982 |
| 1869 | 60,931 | 461,023 | 962 | 7,671 | 1,455 | 11,626 |
| 1870 | 67,045 | 495,276 | 744 | 5,953 | 1,899 | 15,181 |
| 1871 | 70,427 | 537,906 | 887 | 7,071 | 2,607 | 20,815 |
| 1872 | 79,863 | 840,660 | 982 | 9,429 | 5,023 | 48,181 |
| 1873 | 81,393 | 999,074 | 1,266 | 17,698 | 5,265 | 73,630 |
| 1874 | 80,866 | 810,355 | 1,175 | 14,098 | 5,202 | 62,364 |
| 1875 | 83,633 | 723,086 | 1,633 | 19,576 | 2,143 | 37,634 |
| 1876 | 80,759 | 630,978 | 1,871 | 22,413 | 3,141 | 25,689 |

In 1875 the number of ironfoundries in Belgium was 177, with 275 cupolas and 8 air furnaces. Their motive power was supplied by 133 steam engines of 1,006 horse-power, and by 8 water wheels of 81 horse-power in the aggregate. The number of hands employed was 4,389. The production of castings was 83,633 metric tons, of a value of £724,141, half of which was turned out in the province of Hainault.

The following is a tabular return of the foreign trade in the manufactured goods mentioned above :—

| | Import. | | | Export. | | |
|---|---|---|---|---|---|---|
| | 1877. | 1876. | 1875. | 1877. | 1876. | 1875. |
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. |
| Pig and Scrap-iron | 193,380 | 207,264 | 146,886 | 12,027 | 9,480 | 15,672 |
| Forged and Rolled Iron—Wire | 4,191 | 4,115 | 2,182 | 2,013 | 2,040 | 2,920 |
| Forged and Rolled Iron—Rails | 448 | 612 | 3,442 | 44,674 | 43,741 | 60,398 |
| Forged and Rolled Iron—Plates and Sheets | 335 | 241 | 258 | 16,481 | 20,041 | 22,923 |
| Forged and Rolled Iron—Divers | 4,482 | 3,919 | 3,789 | 112,578 | 100,338 | 96,426 |
| Total of Forged and Rolled Iron | 9,456 | 8,887 | 9,671 | 175,746 | 166,160 | 182,667 |
| Wrought-iron Hardware—Anchors and Chains | 126 | 239 | 219 | 1 | 5 | 2 |
| Wrought-iron Hardware—Nails | 415 | 542 | 618 | 10,175 | 11,790 | 12,300 |
| Wrought-iron Hardware—Divers | 2,519 | 3,461 | 3,324 | 13,653 | 13,687 | 9,311 |
| Total of Wrought-iron Hardware | 3,060 | 4,242 | 4,156 | 23,829 | 25,482 | 21,613 |
| Castings | 1,459 | 1,871 | 1,633 | 2,114 | 3,141 | 2,143 |
| General Total | 207,355 | 222,264 | 162,346 | 213,716 | 204,263 | 222,095 |

This table is highly interesting, as in the first instance it proves that almost the whole raw material imported into Belgium is exported again in the shape of manufactured goods; and secondly, that the demand for forged and rolled iron, which was most feeble in 1876, exhibits unmistakable signs of improvement in 1877.

The quantities may be distributed amongst the different countries concerned, as follows:—

| Import. From | 1877. | 1876. | 1875. | Export. To | 1877. | 1876. | 1875. |
|---|---|---|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. | | Metric Tons. | Metric Tons. | Metric Tons. |
| Sweden and Norway | 2,662 | 3,171 | 3,436 | Russia | 13,716 | 25,054 | 19,509 |
| Prussia | 41,999 | 33,887 | 22,978 | Sweden and Norway | 1,657 | 2,955 | 5,396 |
| Grand Duchy of Luxemburg | 59,870 | 78,414 | 45,901 | Denmark | 965 | 1,136 | 1,238 |
| Holland | 15,887 | 10,800 | 6,968 | Prussia | 6,478 | 6,089 | 15,575 |
| England | 33,044 | 90,479 | 77,492 | Grand Duchy of Luxemburg | 2,014 | 1,418 | 3,959 |
| France | 4,144 | 5,399 | 5,544 | Saxony and Bavaria | 223 | 268 | 846 |
| Other Countries | 245 | 111 | 25 | Bremen | 222 | 580 | 630 |
| | | | | Hamburg | 10,014 | 8,730 | 5,823 |
| Total | 207,351 | 222,261 | 162,344 | Holland | 47,006 | 49,457 | 42,072 |
| | | | | England | 52,662 | 36,752 | 33,792 |
| | | | | France | 21,893 | 22,279 | 25,136 |
| | | | | Portugal | 1,012 | 1,226 | 4,055 |
| | | | | Spain | 9,943 | 7,217 | 6,135 |
| | | | | Italy | 9,447 | 15,318 | 15,941 |
| | | | | Switzerland | 8,401 | 14,198 | 22,902 |
| | | | | Austria | 562 | 1,024 | 1,387 |
| | | | | Turkey | 2,295 | 1,285 | 8,213 |
| | | | | China | 5,752 | 2,614 | 4,132 |
| | | | | British India | 222 | 208 | .. |
| | | | | Cuba and Porto Rico | 1,221 | 1,196 | 1,690 |
| | | | | British Colonies | 427 | 92 | 383 |
| | | | | Brazil | 13,127 | 2,272 | 822 |
| | | | | Uruguay | 72 | 121 | 39 |
| | | | | Argentine Republic | 1,218 | 525 | 416 |
| | | | | Chile and Peru | 819 | 490 | 487 |
| | | | | Other Countries | 2,335 | 1,735 | 1,504 |
| | | | | Total | 213,703 | 204,249 | 222,082 |

Only three of the Belgian works are engaged in cast-steel manufacture. All

of them belong to the province of Liége. They are the steelworks of the Cockerill Company, having 8 converters; that of Messrs. F. de Rossius, Pastor, & Cie., at Angleur, having 4 converters; and lastly, that of the Sclessin Company at Tilleur, where the Martin process has been introduced.

The greatest part of the pig-iron used by these works comes from England. The first-named company has indeed two furnaces making Bessemer iron, but the production is insufficient even for the wants of the company's own steelworks.

The following table gives the annual production of Bessemer steel in Belgium, from the time when its manufacture was first introduced :—

| Year. | Number of Works. | Number of Converters. | Total Production. | Total Value. | Average Price per Ton. |
|---|---|---|---|---|---|
| | | | Metric Tons. | £ | £ |
| 1864 | 1 | 1 | 296 | 5,866 | 20 |
| 1865 | 1 | 1 | 969 | 17,169 | 18 |
| 1866 | 1 | 1 | 1,460 | 23,332 | 16 |
| 1867 | 1 | 1 | 1,767 | 24,426 | 14 |
| 1868 | 1 | 1 | 2,509 | 31,765 | 13 |
| 1869 | 1 | 1 | 3,699 | 46,432 | 13 |
| 1870 | 1 | 2 | 5,977 | 74,359 | 12 |
| 1871 | 1 | 4 | 10,854 | 126,750 | 12 |
| 1872 | 1 | 4 | 14,985 | 204,326 | 14 |
| 1873 | 2 | 7 | 21,268 | 339,491 | 16 |
| 1874 | 2 | 10 | 36,584 | 460,837 | 13 |
| 1875 | 2 | 12 | 53,500 | 552,541 | 10 |
| 1876 | 2 | 12 | 71,758 | 592,020 | 8 |

Of the 12 converters existing, 4 are kept in reserve. In 1876 65,000 metric tons of steel rails were made, of a total value of £540,251, corresponding to an average price of £8 6s. 2d. per metric ton. This quantity was 44% of the entire quantity of rails turned out in Belgium. The production of 1877 is certain to have increased at least 50%.

The returns of the manufacture of Bessemer steel just stated were obtained from the works, and are not coinciding with the official statistics, which comprise three works instead of two only, but nevertheless return smaller figures, as shown by the following table :—

| Year. | Production. | | Import. | | Export. | |
|---|---|---|---|---|---|---|
| | Quantity. | Value. | Quantity. | Value. | Quantity. | Value. |
| | Metric Tons. | £ | Metric Tons. | £ | Metric Tons. | £ |
| 1840 | ... | ... | ... | 47,981 | ... | ... |
| 1850 | ... | ... | ... | 51,777 | ... | ... |
| 1860 | 3,172 | 33,919 | ... | 106,270 | ... | ... |
| 1866 | 3,820 | 65,900 | ... | ... | ... | ... |
| 1867 | 2,833 | 45,616 | ... | 229,680 | ... | ... |
| 1868 | 2,510 | 39,405 | 3,195 | 188,530 | 289 | 20,535 |
| 1869 | 5,490 | 87,493 | 4,256 | 243,024 | 434 | 35,996 |
| 1870 | 9,563 | 96,976 | 5,436 | 289,967 | 853 | 76,467 |
| 1871 | 8,900 | 126,646 | 9,673 | 265,317 | 4,519 | 132,878 |
| 1872 | 15,284 | 230,958 | 15,196 | 445,617 | 2,703 | 132,558 |
| 1873 | 19,056 | 310,821 | 17,395 | 521,564 | 4,321 | 218,853 |
| 1874 | 20,953 | 357,884 | 10,189 | 342,782 | 5,234 | 223,528 |
| 1875 | 47,200 | 564,272 | 5,342 | 183,616 | 7,319 | 263,639 |
| 1876 | 75,258 | 624,878 | 6,137 | 183,176 | 5,567 | 201,994 |

The extensive works of the John Cockerill Company at Seraing give employment to 8,750 workmen; 259 steam engines of 6,600 horse-power serve as motors, and the daily consumption of fuel exceeds 1,000 metric tons. The value of the annual production is £1,598,052. Up to the present 40,000 engines and other mechanical appliances, as well as 390 vessels, have been made at these works. They are able to turn out 100 locomotive and 70 stationary engines, 1,500 machines of different descriptions, 8,000 metric tons of bridgework, turntables, &c., and 14 sea-going steamers or ironclads per annum.

The import and export of steel has much increased during the last year, the latter exceeding the former by 12,000 metric tons.

| | Import. | | | Export. | | |
|---|---|---|---|---|---|---|
| | 1877. | 1876. | 1875. | 1877. | 1876. | 1875. |
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. |
| Ingots | 677 | 1,290 | 114 | 15 | 181 | 4 |
| Bar Steel | 3,442 | 3,926 | 4,209 | 13,349 | 3,733 | 5,737 |
| Steel Manufactures | 540 | 921 | 1,018 | 2,163 | 1,653 | 1,577 |

Prussia is the foremost of the countries exporting steel into Belgium, the best customers of Belgium being the Mediterranean countries, Spain, Italy and Turkey.

# GERMANY.*

## 539,798 SQUARE KILOMETRES. 42,750,000 INHABITANTS.

## COAL.

THE century during which coal was used as fuel in Germany for the first time is not known. It is very likely that in very remote ages people were already well aware of the combustive property of this black mineral in consequence of

* LITERATURE.—J. Pechar and Dr. A. Peez, Mineralische Kohle, Wiener Ausstellungsbericht. Vienna, 1874.

Die Steinkohlen Deutschlands and anderer Länder von Geinitz, Fleck und Hartig. Munich, 1865.

Zinken, Braunkohlen. Hanover, 1867.

Publicationen des Vereins für bergbauliche Interessen in Dortmund.

Berichte des Oberschlesischen Berg-und Hüttenmännischen Vereins, von Dr. Frantz, Zeitschrift für Gewerbe, Handel, &c. Beuthen.

Zeitschrift für Berg Hütten, und Salinenwesen. Berlin.

Von Viebahn, Statistik des zollvereinten Deutschlands. Vol. I., p.p. 365-720; vol. II., 349-409. Berlin.

Statistik des deutschen Reichs, herausgegebenvom Kaiserl. statistischen Amt.

Engel, Zeitschrift für Statistik des Preussischen Staates.

W. von Lindheim, Kohle und Eisen. Vienna, 1877.

Karte über die Production, Consumtion, und die Circulation der mineralischen Brennstoffe in Preussen während des Jahres 1871, herausgegeben im Kön. Preuss. Ministerium für Handel, Gewerbe, und öffentl. Arbeiten. Berlin

the great number of seams cropping out at the surface; but that it was not used as fuel for centuries—partly on account of the abundance of wood, and, perhaps, not less of the primitive state of all firing and heating appliances. The district of Zwickau, in the kingdom of Saxony, seems to have been the first in Germany where coal was mined, which, as it appears, was done by the native inhabitants of that country—the Sorbs and Wends—as far back as the 10th century. The Zwickau metal-workers, in the year 1348, were forbidden by the local authorities to use coal for smith's work, on account of the smoke poisoning the air. In the Ruhr district (Dortmund) the first reports concerning the use of coal date from 1302; in Essen from 1317. It is said that in the neighbourhood of Aix-la-Chapelle, coalmining was carried on as early as the 11th or 12th century. In the Saar district the first beginnings date from 1529, and in Silesia, most likely, only from the end of the Thirty Years' War. The ordinary use of coal for domestic purposes is of the most recent date, and the rapid and universal increase of mining operations commenced only 10 to 20 years ago, when the demand for coal was greatly increased in consequence of the general introduction of steam power, the rapid growth of the iron trade, the extension of railways and of steam navigation, the diminishing supply of firewood for domestic purposes, the increase of export &c., &c. The entire yearly output of coal in Germany (exclusive of the German portion of Austria) in the middle of the last century cannot have exceeded 150,000 metric tons (147,631 English tons), and even in the year 1800 we cannot suppose a greater quantity than about 500,000 metric tons (492,105 English tons) to have been raised. Now the annual production in the German empire amounts to 37,500,000 metric tons (36,907,875 English tons), or seventy-five times the estimated average quantities of the first year of this century.

The following table indicates the increase in the output, and in its corresponding value:—

| Year. | Metric Tons. | Value in £ sterling. | Year. | Metric Tons. | Value in £ sterling |
|---|---|---|---|---|---|
| 1848 | 4,383,565 | 1,253,450 | 1870 | 26,397,770 | 8,008,738 |
| 1853 | 8,328,760 | 2,513,523 | 1871 | 29,373,272 | 10,693,100 |
| 1857 | 11,279,266 | 4,051,740 | 1872 | 33,306,418 | 14,528,450 |
| 1862 | 15,576,278 | 4,069,470 | 1873 | 36,392,280 | 19,767,317 |
| 1866 | 21,629,746 | 6,235,120 | 1874 | 35,918,614 | 18,961,119 |
| 1867 | 23,808,071 | 6,729,448 | 1875 | 37,436,368 | 14,568,417 |
| 1868 | 25,704,758 | 7,139,681 | 1876 | 38,454,428 | 12,912,853 |
| 1869 | 26,774,368 | 7,629,113 | 1877 | 37,576,071 | 10,631,220 |

The percentage of the increase of production was:—

| | According to Weight. | According to Value. |
|---|---|---|
| From 1848 to 1868 ..... | 586·4 % ..... | 567·2 % |
| „ 1868 to 1875 ..... | 145·6 „ ..... | 204·0 „ |
| „ 1848 to 1875 ..... | 854·0 „ ..... | 1157·5 „ |

Amongst the different countries and provinces of the German empire* the output of 1875 is to be divided as follows:—

* The figures of the output for the years 1876-77 were not published by the statistical office of the German empire before April, 1878, when this report had already been printed. The latest publications have been subsequently included as far as possible.

| | Number of Mines. | Output. Metric Tons. | Average Value per Metric Ton. | Number of Workmen. |
|---|---|---|---|---|
| | | | s. d. | |
| Prussia | 448 | 33,419,299 | 7 5 | 159,702 |
| In the province of Silesia ..... 152 | | 10,444,364 | 6 3 | 43,506 |
| „ „ Hanover ..... 21 | | 435,231 | 9 9 | 3,753 |
| „ „ Westfalia ..... 161 | | 10,749,025 | 7 3 | 54,027 |
| „ „ Rhineland ..... 110 | | 11,645,014 | 8 5 | 57,258 |
| Bavaria | 43 | 457,929 | 9 9 | 3,284 |
| Saxony | 78 | 3,061,275 | 10 7 | 17,272 |
| Baden | 3 | 9,782 | 12 8 | 121 |
| Weimar | 1 | 86 | 25 4 | 7 |
| Oldenburg (Birkenfeld) | 2 | 12 | 11 9 | 10 |
| Meiningen | 1 | 1,644 | 10 0 | 29 |
| Gotha | 2 | 457 | 20 2 | 28 |
| Schaumburg-Lippe | ... | 100,780 | 11 9 | 760 |
| Lorraine | 2 | 385,104 | 10 2 | 2,610 |
| Total | 580 | 37,436,368 | 7 10 | 183,823 |

It appears from this table that 89% of the total quantity was raised in Prussia.

The output of the Kingdom of Prussia was :—

| | Metric Tons. | | Metric Tons. |
|---|---|---|---|
| In 1862 | 13,088,391 | In 1874 | 31,938,783 |
| „ 1866 | 18,628,548 | „ 1875 | 33,419,299 |
| „ 1870 | 23,316,238 | „ 1876 | 34,466,249 |
| „ 1872 | 29,523,776 | „ 1877 | 33,682,914 |

The output for the last two years in Prussia may be distributed as follows :—

| | 1876. Metric Tons. | | 1877. Metric Tons. |
|---|---|---|---|
| Mining District of Breslau | 10,618,380 | | 10,102,637 |
| „ „ of Halle | 42,035 | | 35,472 |
| „ „ of Dortmund | 17,902,412 | | 17,728,252 |
| „ „ of Bonn | 5,548,680 | | 5,496,838 |
| „ „ of Clausthal | 354,742 | | 319,714 |
| Total | 34,466,249 | | 33,682,914 |

## COAL DISTRICTS.

1. Of all the coalfields of the German empire none is equal in importance to that of the *Lower Rhine* and *Westfalia*, which is commonly called the *Ruhr* basin, although this river only runs through the southern part of it. The extent of this district is not yet exactly known, seeing that in the course of the last few years important seams have been discovered in its northern and eastern parts. The superficial area of the coal-bearing strata may however safely be set down at more than 2,800 square kilometres (1,080 square miles), and the available quantity of coal 45,000 millions of metric tons (44,289,450,000 English tons), which would allow the present rate of output of coal, 17,500,000 metric tons (17,223,675 English tons), to be continued for more than 2,000 years. Forty per cent of this immense quantity lies at depths not exceeding 200-250 metres.

The number of seams is considerable, there being more than 60, of an aggregate thickness of 50, 60, and 70 metres or more of pure coal. The average thickness of each seam is 1 to 1·10 metres.

Under such circumstances the natural conditions for mining are very favourable. Herr von DECHEN, the well-known geologist, says "that the formation into curved strata—which is peculiar to all the mineral beds in this district, and consequently to the coal seams also—the 'troughs' and 'saddlebacks,' the concentration of mineral wealth in the upper depths, bringing it within easy reach of the miner, are circumstances so favourable that, if they were devised for the purpose of assisting mining enterprise, no better choice could have been made." Of course the quality of the coal in such an extensive district, and consequently its fitness for various uses varies very much. Generally speaking, however, the coal of the Ruhr district may be classed as an excellent fuel, and, if a proper selection be made, as well able to fulfil all the requirements of the different branches of trade. Only a few years ago English coal was decidedly preferred in the German seaports, and even the German Imperial navy used English coal exclusively. To the mineowners and managers of Rhineland and Westfalia, however, and chiefly to the ASSOCIATION FOR EXPORTING COAL (which owes its existence principally to the efforts of Mr. MULVANY of Düsseldorf), is due the credit of correcting this erroneous estimate of German coal. It has been proved by trials on a large scale, made for the Imperial navy, that Westfalian coal surpasses the English in regard to heating power, quantity of ashes, time of emission of smoke, and that it is only in a slight degree inferior to the best descriptions of English coal as regards its cohesive strength.*

Other trials for the purpose of comparing English and German coal have recently been made at Copenhagen on behalf of the Danish railway directors, and have resulted decidedly in favour of German coal. 4·09lb. of water were evaporated by half a pound of Westfalian coal; 635·5lb. of it left 39·5lb. of ashes and other residues. 3·805lb. of water were evaporated by half a pound of English coal, 578lb. of which left 56·5lb. of ashes. As a further proof we subjoin the analyses of different descriptions of coal from the Ruhr district.

| LOCALITY. | In 100 units of weight of dry coal there were contained | | | | Available Evaporative Power for 0·5 Kilog. of Coal. | Weight of Gases Escaping in the Coke Oven, per cent. | Return of Coke, per cent. | Ashes, per cent. |
|---|---|---|---|---|---|---|---|---|
| | Carbon. | Hydrogen. | Oxygen and Nitrogen. | Ashes. | | | | |
| Essen | 85·62 | 4·65 | 7·64 | 2·09 | 7·47 | 21·4 | 78·5 | 2·1 |
| Bochum | 85·90 | 4·56 | 4·77 | 1·56 | 7·66 | 20·4 | 78·8 | 3·2 |
| Dortmund | 82·22 | 5·00 | 7·71 | 5·07 | 7·16 | 18·4 | 80·2 | 3·8 |
| Barop | 78·05 | 5·05 | 12·92 | 3·98 | 7·37 | 25·5 | 73·3 | 1·2 |
| Witten | 83·79 | 4·44 | 6·23 | 5·53 | ... | 10·9 | 88·2 | 0·9 |

The output of the Ruhr district was as follows :—

| | Metric Tons. | | Metric Tons. |
|---|---|---|---|
| In 1737 | 20,724 | In 1860 | 4,366,000 |
| „ 1800 | 177,082 | „ 1870 | 12,219,432 |
| „ 1840 | 993,108 | „ 1873 | 16,219,914 |
| „ 1850 | 1,694,208 | „ 1877 | 17,728,252 |

* A more detailed account of these trials will be found in the part headed "Coal," in our article, "Great Britain."

Up to the year 1860 the coalmines of this district were not very prosperous. From about 1857, however, the production increased enormously, owing to the increasing predilection of the public to invest capital in mining and ironmaking companies. Since that time numerous other industries have been introduced there, the existing works have been greatly extended, and—next to Saxony—Rhineland and Westfalia are at present the most industrial provinces of the empire. They surpass even Saxony in regard to the importance of their individual concerns. The important manufacturing towns of Essen, Dortmund, Bochum, Oberhausen, Hörde, Hamm, &c., are not only centres of coalmining but iron manufacturing also. At a few miles distant from these places, other manufactures are found in great numbers and of considerable extent, by which a considerable portion of the output of coal is continually absorbed.

The smaller coal districts of Osnabrück, Ibbenbüren, Minden (in the vicinity of the Teutoburg forest) are generally apportioned to the Ruhr district, although partially belonging to other geological formations.

2. The coal district of *Aix-la-Chapelle* (*Inde* and *Wurm* district) may be considered as an extension of the Belgian coal measures, on account of the irregularity of the numerous seams, which are interrupted by many faults and extend to great depths. The actual extent of this district cannot be stated with certainty, as there is an opinion that recent investigations justify the enlargement of the limits of both basins constituting it (that of the river Inde, near Eschweiler, and that of the Wurm, near Aix-la-Chapelle). The seams are worked under greater difficulties than in most other German coal districts, but they contain a good caking coal, which (in addition to the proximity of a considerable trade in iron, lead, zinc, textile fabrics of all descriptions, paper, glass, &c.,) renders the mining enterprises paying concerns. The present annual production of coal—1,250,000 metric tons (1,230,262 English tons)—has increased about 80 per cent since 1860.

3. The *Saar* (or Saarbrücken) district is bounded by the rivers Saar, Nahe, and Blies. It is situated in the south-western part of the Prussian province of Rhineland, and extends eastwards to the Bavarian Palatinate (Pfalz), westwards to German Lorraine, for a length of 99, and a breadth of about 30 kilometres. The aggregate thickness of the seams (of which thereare more than 100 overlying each other), as far as they have been reached amounts to more than 80 metres of coal. Other underlying seams are said to extend to a depth of 6,000 metres below the level of the sea. Of course they cannot be worked by any means which mining engineers have at present at their disposal. The quantity of the entire deposit between the rivers Saar and Blies is estimated by Herr von DECHEN at 45,400 millions of metric tons (44,683,134,000 English tons), or equal to that of the Ruhr district.

The coal of this district is, generally speaking, of a good quality. The different descriptions are used for heating, coke, and gas-making with fairly good results. Subjoined are the results of some analyses of Saar coal made by M. HEINTZ and Dr. BRIX.

| Locality. | In 100 units of weight of dry coal there were contained | | | | Available Evaporative Power per lb. of Coal. |
|---|---|---|---|---|---|
| | Carbon. | Hydrogen. | Oxygen and Nitrogen. | Ashes. | |
| Gerhard Mine | 72·38 | 4·46 | 15·05 | 8·11 | 7·03 |
| Heinitz Mine | 80·53 | 5·06 | 11·91 | 2·50 | 7·74 |
| Dudweiler Mine | 87·29 | 5·30 | 3·54 | 4·87 | 7·46 |

Mining operations in the Saar district are rendered difficult by numerous faults; firedamp also is more common here than in many other German coalfields. Some trouble is sometimes occasioned by pyrites, as proved by the burning hill of Dudweiler, which has been in this state for two centuries. The output of the Saar district was :—

| | Metric Tons. | | Metric Tons. |
|---|---|---|---|
| In the year 1816 ..... | 97,496 | In the year 1860 ..... | 1,505,961 |
| „ 1820 ..... | 98,467 | „ 1870 ..... | 2,734,319 |
| „ 1830 ..... | 194,934 | „ 1872 ..... | 4,222,234 |
| „ 1840 ..... | 386,082 | „ 1877 ..... | 4,992,460 |
| „ 1850 ..... | 577,139 | | |

By far the greatest portion of the output is raised from the mines owned by the State; and the output of private mines in Prussian Rhineland, as well as in the adjoining districts of Bavaria and Lorraine, falls very short of it. The iron, glass, tile, brick, and chemical works of the district insure a ready sale for the coal, but the greater portion of the output is conveyed out of the district.

4. The coalfield of *Upper Silesia* is situated in the southern part of Silesia, in the departmental districts of Ratibor, Beuthen, Pless, and Rybnik. It comprises an area of 478 square kilometres (184 square miles), and, according to the calculations of Herr von DECHEN, it contains, to a depth of 600 metres, the enormous quantity of 50,000 millions of tons of coal; and to a greater depth, which however is at present out of reach, even a further quantity of four billions of hundredweights. The coal measures extend over the neighbouring frontiers to the south into Austria and to the east into Poland. The seams are fairly regular; accordingly the cost of working is moderate. Most of the seams are 3 to 4 metres thick; but it is just this great thickness that stands often in the way of working the seams clean out. The heating value of the Upper Silesian coal is not inferior to that of the best descriptions of German and foreign coal. The different sorts of it are profitably used for all purposes to which coal can be applied. A quality inherent to this coal in a higher degree than to nearly every kind of English and Westfalian (Ruhr) coal is its cohesive (relative) strength, and it is on that account that 30 to 40 per cent of the entire output is raised and disposed of as cop coal.

Analyses of Upper Silesian coal (Königsgrube) :—

| Carbon. | Hydrogen. | Nitrogen. | Sulphur. | Oxygen. | Ashes. | Units of Heat (C. Scale.) | Return of Coke. |
|---|---|---|---|---|---|---|---|
| % | % | % | % | % | % | | % |
| No. 1.—86·020 ..... | 6·003 | 1·101 | 0·274 | 4·410 | 2·192 | 7985·3 | 75·740 |
| No. 2.—83·970 ..... | 5·400 | 0·651 | 0·932 | 6·020 | 3·027 | 7637·3 | 71·041 |
| No. 3.—83·075 ..... | 5·004 | 0·527 | 0·165 | 9·676 | 1·550 | 7368·1 | 70·705 |

The output was :—

| | Metric Tons. | | Metric Tons. |
|---|---|---|---|
| In 1790 ..... | 7,850 | In 1872 ..... | 7,251,838 |
| „ 1842 ..... | 546,858 | „ 1873 ..... | 7,839,315 |
| „ 1860 ..... | 2,478,276 | „ 1876 ..... | 8,467,743 |
| „ 1870 ..... | 5,854,403 | „ 1877 ..... | 8,101,052 |

In the year 1877 the mines owned by the State yielded 1,952,692 metric tons (1,921,859 English tons); those possessed by private persons, 6,148,360 metric tons (6,051,277 English tons). Not exactly in the coal measures, but in the

tertiary formation adjoining, brown iron ores and clay ironstone are found, which have been the foundation and support of the Upper Silesian iron industry. Apart from the latter the zinc industry of this district is an important factor in the local demand for coal.

5. The *Lower Silesian* coalfield of Waldenburg and Neurode is much inferior to the Upper Silesian, both as regards the superficial area of the coal measures and the contents of the seams. The difficulty of working the mines profitably is much increased by the prevalence of water and by slips or faults in the strata, as also by the high rate of wages.

The Lower Silesian coal, however, is famous on account of its caking quality, and is therefore in good demand for coking; besides, the district is favoured by the vicinity of populous towns and important manufactures, and thus a higher price is obtained for this coal than for that of the Upper Silesian mines, which are in other respects more advantageously situated.

Analyses of Waldenburg coal.

| Locality. | Composition. | | | | One Kilog. of Coal (Ashes included) produces | | Percentage of Coke from the Raw Coal. |
|---|---|---|---|---|---|---|---|
| | Carbon. | Hydrogen. | Oxygen and Nitrogen. | Ashes. | Units of Heat. | Kilogram of Steam. | |
| | % | % | % | % | | | % |
| Weisstein ..... | 81·59 | 5·01 | 10·52 | 2·88 | 158·06 | 8·27 | 67·2 |
| Hermsdorf ..... | 83·77 | 4·96 | 8·61 | 2·66 | 160·80 | 8·41 | 67·4 |
| Waldenburg ..... | 81·94 | 4·77 | 10·76 | 2·53 | 154·76 | 8·10 | 69·4 |

Of the entire output about 13 per cent are cops, 3 per cent round coal, 52·8 per cent nuts, and the remainder slack. The output was:—

| | Metric Tons. | | Metric Tons. |
|---|---|---|---|
| In the year 1740..... | 1,900 | In the year 1860..... | 758,515 |
| „ 1790..... | 62,190 | „ 1870..... | 1,570,227 |
| „ 1850..... | 400,170 | „ 1877..... | 2,102,256 |

6. Amongst the coal districts of the kingdom of *Saxony* the most important are those of *Zwickau* and of *Lugau*, which are in close proximity to each other, the latter having only recently been opened. These districts are also much inferior to those of the Ruhr, the Saar, and Upper Silesia, as regards the extent of their coal measures; besides, mining operations are here more difficult than in many other places, on account of the great number of faults and much water in the strata, and (at least near Lugau) of the considerable depth of the better seams. The mines here are very fiery, of which we have sufficient evidence in the fact that at Lugau, in the year 1869, nearly 100 men, and in the Plauen valley, two years afterwards, more than 200 men lost their lives by firedamp. But here, under a comparatively small area of surface, a great quantity of a fairly good coal is stored up. As a proof of this we may mention that the deepest seam opened up to the present in the Lugau district consists of a highly bituminous coal 14·3 metres thick. The little coal basin of the Plauen valley, near Dresden, is entirely isolated from the former. It produces a coal of medium quality, which, however, will be exhausted in about 100 years.

Analysis of Saxon coal made by Dr. Fleck:—

| Locality. | Carbon. | Hydrogen. | Oxygen and Nitrogen. | Ashes. | Available Heating Power of 0·5 Kilog. of Coal. |
|---|---|---|---|---|---|
| Oberhohndorf, near Zwickau.. | 83·96 | 4·11 | 9·62 | 2·29 | 6·78 |
| Planitz ..... | 76 96 | 4·40 | 16·09 | 2·54 | 6·25 |
| Zwickau ..... | 77·98 | 4·05 | 12·85 | 5·12 | 6·48 |
| Lugau ..... | 80·12 | 3·65 | 11·49 | 4·74 | 6·35 |
| Niederwürschnitz ..... | 76·75 | 4·85 | 13·48 | 4·92 | 5·34 |
| Zauckeroda ..... | 70·32 | 4·52 | 12·47 | 12·69 | 6·34 |
| Burgk ..... | 63·84 | 3·81 | 11·08 | 21·19 | 5·39 |

The last two descriptions (from Zauckeroda and Burgk) are from the Plauen valley.

The output of coal in the kingdom of Saxony was :—

| | Metric Tons. | | Metric Tons. |
|---|---|---|---|
| In the year 1846 ..... | 475,065 | In the year 1874 ..... | 3,042,254 |
| „ 1856 ..... | 1,149,854 | „ 1875 ..... | 3,061,276 |
| „ 1866 ..... | 2,201,680 | „ 1876 ..... | 3,037,853 |
| „ 1872 ..... | 2,946,260 | | |

Generally speaking, the Saxon coal measures yield only a medium quality of coal, as has been already mentioned, which, however, owing to the density of the population and the numerous and important manufactures, meets with a ready sale.

Besides these large districts there are smaller deposits of coal in Upper Bavaria, Baden, Weimar, Gotha, and other places, but their yield is not of great importance.

## LIGNITE.

The German empire is almost as well provided with lignite as with coal. Along the whole northern slope of the mountain ranges of central Germany, from the Riesengebirge, in Silesia, to the far west, nearly up to the Weser and the Rhine, there is a tract, in some places many miles broad, sometimes interrupted at larger intervals, and frequently divided into two, three, or more parallel zones, but always reappearing, containing lignite throughout. Thus, lignite is found in Lower Silesia, in Prussian and Saxon Lusatia, in the northern portion of the kingdom of Saxony, in Thuringia, as far as Hesse and the Westerwald. But frequently its heating power is, in consequence of earthy admixtures, inferior even to that of peat, and cannot either be profitably raised, or it supplies only a very restricted local demand, as it would not pay to carry it to any distance. The seams are rarely very deep, and often admit of open workings; the cost of production and the prices are consequently very low. Better descriptions, however, are found in certain districts, of greater or smaller extent—as on the Westerwald, on the Meissner in Hesse, in the Wetterau on the Taunus, near Merseburg and Weissenfels in Thuringia, in Anhalt, near Spremberg and Frankfurt-on-the-Oder, near Zittau in Saxony, and in Brunswick—but even these descriptions cannot compete with the Bohemian lignite as to quality, and can therefore only satisfy the local demand. Of late, however, partially successful attempts have been made to render them fit for transport in the shape of artificial fuel (briquettes).

In the Prussian province of Saxony, particularly in the vicinity of Weissenfels, Merseburg, and Zeitz, and in the Duchy of Anhalt, there are found lignites fit for

manufacturing mineral oils, paraffine, stearine, and their derivative compounds. Considerable quantities of paraffine and of mineral oils are manufactured, and an industry has grown up promising great vitality. The production of mineral oils has, however, of late been restricted by the competition of American petroleum.

The output of lignite in the German empire was :—

| Year. | Metric Tons. | Value in £ Sterling. | Year. | Metric Tons. | Value in £ Sterling. |
|---|---|---|---|---|---|
| 1848 | 1,417,420 | 185,549 | 1870 | 7,605,234 | 1,079,985 |
| 1853 | 2,385,796 | 343,262 | 1871 | 8,482,838 | 1,283,685 |
| 1857 | 3,587,855 | 551,909 | 1872 | 9,018,048 | 1,444,459 |
| 1862 | 5,084,399 | 690,999 | 1873 | 9,752,914 | 1,695,732 |
| 1866 | 6,533,059 | 923,029 | 1874 | 10,739,532 | 1,921,263 |
| 1867 | 6,994,818 | 981,939 | 1875 | 10,367,686 | 1,806,341 |
| 1868 | 7,174,365 | 979,759 | 1876 | 11,096,034 | 1,882,610 |
| 1869 | 7,569,545 | 1,030,943 | 1877 | 10,720,296 | 1,749,167 |

The percentage of increase (the initial figures of each period being=100) was as follows :—

| | Weight. | Value. |
|---|---|---|
| | % | % |
| 1848—1868 | 506·1 | 527·9 |
| 1868—1875 | 144·5 | 184·3 |
| 1848—1875 | 731·4 | 973·3 |

The production during 1875, amounting to 10,367,686 metric tons (10,203,980 tons English), is to be divided amongst the different countries as follows :—

| Countries. | No. of Mines. | Output. Metric Tons. | Average Value per Ton. | Number of Workmen. |
|---|---|---|---|---|
| | | | s. d. | |
| In the province of Silesia | 45 | 439,902 | 3 9 | 1,365 |
| „ „ Brandenburg | 106 | 1,510,197 | 2 11 | 3,399 |
| „ „ Saxony | 275 | 6,012,225 | 3 6 | 11,562 |
| „ „ Hesse & Nassau | 48 | 208,371 | 5 11 | 1,437 |
| „ „ Rhineland | 42 | 147,087 | 2 4 | 620 |
| Kingdom of Prussia—Total | 525 | 8,340,259 | 3 6 | 18,538 |
| Kingdom of Saxony | 161 | 596,382 | 3 4 | 3,243 |
| Brunswick | 5 | 191,349 | 4 1 | 1,057 |
| Altenburg | 80 | 594,138 | 2 4 | 3,199 |
| Anhalt | 17 | 524,229 | 4 4 | 2,851 |
| Entire German Empire | 815 | 10,367,686 | 3 6 | 25,289 |

In 1876 and 1877 the output of lignite in the kingdom of Prussia amounted to the following figures :—

| | | Metric Tons. | | | Metric Tons. |
|---|---|---|---|---|---|
| In the mining district of | Breslau | 438,210 | less than in 1876 | by | 24,292 |
| „ „ | Halle | 7,987,385 | „ | „ | 240,679 |
| „ „ | Bonn | 126,640 | „ | „ | 16,455 |
| „ „ | Clausthal | 127,474 | „ | „ | 23,988 |
| Entire kingdom of Prussia | | 8,679,709 | „ | „ | 305,414 |

## LABOUR.

The following number of workmen were employed in mining mineral fuel in the German Empire (peat excepted) :—

| | Year 1848. | | Year 1857. | | Year 1875. |
|---|---|---|---|---|---|
| In coal mines ..... | 35,502 | ..... | 77,847 | ..... | 183,823 |
| In lignite mines ..... | 8,698 | ..... | 17,776 | ..... | 25,289 |
| Total ..... | 44,200 | | 95,623 | | 209,112 |

From 1848 to 1857 the number of coal miners was doubled, while from 1848 to 1875 it increased fivefold. The average quantity of coal raised by each miner in the State of Prussia was :—

| Year. | Of Coal. | | Of Lignite. | |
|---|---|---|---|---|
| | Output. Metric Tons. | Value in £ Sterling. | Output. Metric Tons. | Value in £ Sterling. |
| 1848 ..... | 130 | 36 | 163 | 22 |
| 1857 ..... | 145 | 53 | 202 | 31 |
| 1875 ..... | 209 | 78 | 445 | 78 |

It will be difficult to show how much of this increase is due to improvements in the method and appliances for working, and how much to the improved personal efficiency of the miner. The fact cannot, however, be disputed that the workmen have improved remarkably, and that a considerable portion of the increase must be ascribed to this cause.

Up to the Franco-German war of 1870-1871, the state of the German coal miner was fairly satisfactory. The German collier does not equal the English in perseverance, nor perhaps in physical strength, or quick perception, and speedy acquisition of manual skill ; but he is of a steady, contented, and modest character, obedient and compliant, and has the advantage of a good schooling. He is, however, not gifted with great energy, and is not apt to hurry his work. But just these qualities make a fairly good miner of him, and for this reason German miners are much in demand for transatlantic countries.

This short description does not, however, entirely hold good at present. The rapid increase of all branches of industry, from 1871 to 1873, the feverish activity and rise of all prices—unhappily too soon reversed—have exerted a remarkable influence upon the German workman. The rate of wages increased rapidly, but instead of making the men more efficient, it only made them more and more exacting. The cry was, "More wages and less work!" and whenever this could not be obtained from the masters by amicable settlement, strike was resorted to, chiefly in consequence of socialistic agitation. When afterwards (from 1874) the prices of coal fell, and, as a matter of necessity, the wages followed, the miners became even more deaf to reason than before, and even at present the masters are complaining that the great number of their colliers—some exceptions, indeed, allowed—have become untrustworthy and morbid, and have lost, as it were, the love of labour. The old stock of miners has certainly remained unaffected by socialistic preachers and religious agitators, and may be relied upon ; but the behaviour of the younger generation gives rise to anxiety without much hope for a return of the better state of things formerly existing. Certainly it must be remembered here that in the course of the last ten to fifteen years about 100,000 new workmen have been required for coalmining, amongst whom there were most likely not a few without any previous practice, who in consequence were not only inefficient of themselves, but in some cases also apt to exert a mischievous influence upon their fellow workmen.

In consequence of the highly unfavourable state of the coal trade, the former rate of wages has been re-established, and numerous hands have been discharged; but the views of the miners have not been changed, at least not in Saxony, in the Ruhr district, and in a part of Silesia.

The weekly wages (those of women and children included) averaged as follows :

| | 1864. | 1871. | 1873. | 1875. | 1877. |
|---|---|---|---|---|---|
| | s. d. | s. d. | £ s. d. | s. d. | s. d. |
| In the Ruhr district..... | 14 5 | 17 1 | 1 1 11 | 17 1 | 16 4 |
| In the Saar district ..... .. | 13 7 | 16 5 | 1 0 10 | 16 8 | 16 3 |
| In the Upper Silesian district | 12 7 | 16 8 | 0 18 5 | 15 9 | 13 1 |

Wages have accordingly again reached the level prevailing previous to 1871. It remains however to be stated that in no country of the world do employers of labour provide with such care for everything tending to promote the well-being of their workpeople, and their material as well as intellectual improvement, as German mine proprietors and ironmasters do. This is especially the case at works situated away from towns and villages, where co-operative housekeeping and stores, savings banks, improved dwellings, Sunday and evening schools, free libraries, &c., have been widely introduced.

An institution peculiar to Germany, and extending over the whole country, is of equal importance; it is known by the name of *Knappschaft*, and consists of an operative miners' and ironworkers' union, under control and direction of the State, especially of the department superintending the mining concerns of the country. There existed in Prussia in the year 1876 eighty-seven of these district unions, comprising 2,466 works, and 263,687 members. Subvention was paid to 15,070 invalids (men not able to do any work), 640 persons temporarily incapacitated, 19,090 widows, and 32,658 orphan children. Besides this the entire cost of teaching 58,546 children was defrayed by common means. There were reported 109,558 cases of sickness, of an average duration of 17·6 days each, in which wages had to be paid from the common funds. The total revenue of all unions amounted to £588,947, the expenditure to £553,276. This includes the permanent expenditure for invalids and widows pensions and subvention of orphans to the amount of £309,689, of £17,020 for school fees, and £176,485 for the entire cost of medical attendance and medicine. Apart from these items £13,522 were paid in subventions of an occasional and exceptional kind, as, for instance, burial expenses, &c. The average contribution of each member amounted in 1876 to £2 0s. 5d. The entire property of the union at the beginning of the year was £956,722; at the end, £1,003,887; this being £6 15s. 3d. per head of the first category of members on the books at that time.

## PRICE OF COAL.

The average price of a ton of coal in the kingdom of Prussia was as follows :—

| In the year | s. d. | | In the year | s. d. |
|---|---|---|---|---|
| 1848 ... | 5 4 | ..... | 1871 ... | 6 11 |
| 1852 ... | 4 11 | ..... | 1872 ... | 8 5 |
| 1857 ... | 7 1 | ..... | 1873 ... | 10 9 |
| 1862 ... | 5 1 | ..... | 1874 ... | 10 4 |
| 1864 ... | 5 4 | ..... | 1875 ... | 7 6 |
| 1867 ... | 5 5 | ..... | 1876 ... | 6 5 |
| 1870 ... | 5 10 | ..... | 1877 ... | 5 7 |

Accordingly the highest prices of the last thirty years were realised in 1873, the lowest in 1852. The average price per ton of the most current descriptions were, in the several districts, as follows :—

| | | 1852. | 1864. | 1873. | 1876. | 1877. |
|---|---|---|---|---|---|---|
| | | s. d. | s. d. | s. d. | s. d. | s. d. |
| Ruhr district | Cops | 4 7 | 8 8 | 18 9 | 6 8 | 8 10 |
| | Round coal | | 7 4 | 17 1 | | 6 10 |
| | Mixed | | 6 2 | 16 11 | | 5 4 |
| | Slack | | 5 0 | 13 6 | | 4 4 |
| Saar district | Cops | 6 3 | 10 1 | 20 1 | 9 1 | 10 3 |
| | Mixed | | 7 2 | 18 8 | | 7 6 |
| | Slack | | 4 0 | 9 4 | | 3 8 |
| Upper Silesian district. | Cops | 3 5 | 5 5 | 15 0 | 4 11 | 6 7 |
| | Round coal | | 4 11 | 14 1 | | 4 11 |
| | Slack | | 3 5 | 8 3 | | 3 4 |
| Lower Silesian district. | Cops | 5 1 | 8 8 | 16 7 | 7 3 | 9 7 |
| | Slack | | 4 1 | 9 8 | | 4 5 |
| Zwickau district | Cops | 5 7 | 7 0 | 13 8 | ..... | 7 4 |
| | Round coal | | 5 8 | 11 6 | | 5 10 |
| | Slack | | 2 0 | 4 8 | | 2 1 |

## COAL TRAFFIC—IMPORT AND EXPORT.

The importance of railways was duly appreciated in Germany from the beginning, and at present the German Empire surpasses all countries of Europe, Great Britain included, in the total length of its lines, being only second in this respect to the United States of America. The total mileage of railways was—

| In the Year. | Kilometres. | In the Year. | Kilometres. |
|---|---|---|---|
| 1835 ... | 7 ..... | 1872 ... | 22,272 |
| 1840 ... | 350 ..... | 1873 ... | 23,763 |
| 1850 ... | 5,785 ..... | 1874 ... | 24,859 |
| 1860 ... | 10,805 ..... | 1875 ... | 28,142 |
| 1870 ... | 18,806 ..... | 1876 ... | 29,208 |
| 1871 ... | 20,121 ..... | 1877 ... | 30,303 |

The coal districts are, as a matter of course, well intersected by railways, and the principal mines are connected to the main lines by sidings and branch lines. The Ruhr district has the most ample provision in this respect, in consequence of the competition of three great railway companies—the Cologne-Minden, the Bergisch-Märkisch, and the Rhenish.

The coal traffic was :—

| Railways. | 1850. | 1860. | 1870. | 1876. |
|---|---|---|---|---|
| | Metric tons. | Metric tons. | Metric tons. | Metric tons. |
| 1. Bergisch-Märkisch | 55,185 | 1,081,547 | 4,695,946 | 7,874,019 |
| 2. Cologne-Minden | ..... | 1,638,156 | 3,464,718 | 5,477,066 |
| 3. Upper Silesian | 92,668 | 434,324 | 2,265,062 | 3,635,341 |
| 4. Saarbrücken | ..... | 1,483,866 | 1,969,443 | 3,609,234 |
| 5. Rhenish | ..... | 114,682 | 1,710,991 | 3,556,997 |
| 6. Saxon State Line | 41,800 | 906,800 | 2,134,811 | 2,246,000 |
| 7. Lower Silesian-Märkisch | 5,382 | 162,472 | 1,135,836 | 2,065,267 |
| 8. Right Shore of Oder | ..... | ..... | ..... | 1,057,079 |
| 9. Breslau-Schweidnitz-Freiburg | 20,485 | 353,599 | 611,072 | 813,872 |

Much attention has recently been paid to auxiliary railways, and it is to be expected that the existing railway system, and the local traffic, will be increased by a great number of them as soon as better times return.

Considering the great activity in railway extension in Germany, it appears so much more strange that so little has been done for inland navigation. Cheap

conveyance by water is a vital question for coal and iron, and its wants is a chief cause of the inability of the German iron and coal trade to compete with countries better provided in this respect—especially with England and Belgium—in spite of the abundance of German coal, and the superior outfit of German ironworks.

Of the natural waterways of Germany, the Rhine only may be called fairly efficient and reliable. Of the Danube only the upper portion is within German territory, and just there the navigation is obstructed by various impediments. The other rivers, the Weser, Elbe, Oder, and Vistula cannot, as a rule, be considered efficient waterways, except for two or three months after the melting of the snow. As no attention whatever has been paid to the correction of watercourses, much labour and money will now have to be spent in keeping these important means of communication navigable during the summer and autumn months. Besides this, all important rivers (the Danube excepted) are running from south to north, and only a few navigable tributaries (as the Ruhr, Havel, and Spree) are available for traffic, and as a connection of the east and west. Lastly, most of the German coal districts are distant from navigable watercourses, and even the Ruhr and the Saar are not traversing but only touching their districts.

Under such circumstances it would have been advisable to make canals long ago, and to follow the example of England, France, Belgium, and even of Russia. Seventy-two navigable canals, of a total length of about 2,000 kilometres, are indeed in existence, but the greatest part of them are insufficient as to depth of water, size of locks, &c.—in short, in all their dimensions and appliances—and are accordingly of little use for traffic. The coal and iron trades are certainly benefited by the navigation on the Rhine, on the canalised Ruhr, on the Saar, and the adjoining canals; but these are almost the only waterways available to some extent for carrying coal, ores, pig-iron, &c. It would seem that the Prussian Government intends just now to pay more attention to the urgent necessity of artificial waterways, and the projected Rhine-Weser canal, the correction of the Oder, and the projected Oder-Danube canal would be highly serviceable to the mining industries of Westfalia and Silesia.

As regards ocean navigation Germany is much better provided for, although her shipping has little chance of attaining the importance of the British merchant navy in consequence of the limited extent of sea coast. The amount of mercantile shipping was :—

| | Sailing Vessels. | | Steamers. | | Total. | |
|---|---|---|---|---|---|---|
| | No. | Tons Reg. | No. | Tons Reg. | No. | Tons Reg. |
| Beginning of 1876 | 4,426 | 901,313 | 319 | 183,569 | 4,745 | 1,084,882 |
| ,, 1877 | 4,491 | 922,704 | 318 | 180,964 | 4,809 | 1,103,668 |
| In addition, Imperial navy (1877) | 4 | 3,090 | 74 | 162,053 | 78 | 165,143 |

Each of the vessels comprised in this table has a measurement of more than 50 cubic metres gross (17·65 tons register). Apart from these, the German mercantile navy possesses 320 craft of smaller size, of which 12 are steamers, which are registered, but not included in the statistical returns of the German mercantile marine. They are chiefly engaged in the coasting trade on the Baltic estuaries. The entire mercantile navy was manned in the beginning of 1876 by 42,362 men.

The comparatively small area which each of the German coal districts actually supplies with its coal, altogether disproportionate to the enormous mineral wealth and the other opportunities for mining operations, is principally due to the absence of cheap waterways, and to the consequent necessity of a more expensive transport

by rail. During 1877 Germany imported for her seaport towns and northern provinces more than 2,000,000 tons of British coal, while only about 350,000 tons were exported from the North Sea and Baltic ports, chiefly to the neighbouring Scandinavian countries. The quantity exported to Transatlantic places, or even to the European ports of the Atlantic and the Mediterranean, is not worth mentioning. Only of late years the Westfalian coal-owners succeeded, by the greatest efforts, in obtaining a firm footing at least in the German North Sea ports of Bremen, Hamburg, &c., and in restricting English competition there to some extent. If, nevertheless, the quantity of coal exported in 1877 exceeded 5,000,000 tons, it can only have been achieved for the greatest part by means of railway, viz., from the Ruhr and the Aix-la-Chapelle districts to Belgium, Holland, and France; from the Saar to France and Switzerland; and from Silesia to Austria and Russia. The German coal districts are at present obliged to engage in a sharp and unnecessary competition with each other on German soil, instead of having an export trade opened and facilitated by all available means.

We give below the returns for the import and export of coal and lignite for 1862 :—

| | Import. | | | Export. | | |
|---|---|---|---|---|---|---|
| Year. | Coal. | Coke. | Lignite. | Coal. | Coke. | Lignite. |
| | Metric tons. | Metric tons. | Metric tons. | Metric tons. | Metric tons. | Metric tons. |
| 1862 ..... | 894,893 | ... | ... | 2,107,383 | ... | ... |
| 1866 ..... | 1,152,757 | ... | 344,555 | 3,309,273 | ... | 13,912 |
| 1867 ..... | 1,303,662 | ... | 451,081 | 3,805,510 | ... | 13,066 |
| 1868 ..... | 1,648,360 | ... | 608,627 | 3,770,601 | ... | 7,872 |
| 1869 ..... | 1,856,149 | ... | 611,734 | 3,984,828 | ... | 15,116 |
| 1870 ..... | 1,681,573 | ... | 760,711 | 4,067,400 | ... | 1,797 |
| 1871 ..... | 2,395,072 | ... | 874,672 | 3,699,692 | ... | 3,356 |
| 1872 ..... | 2,267,848 | 279,920 | 1,016,733 | 5,789,480 | 26,866 | 19,729 |
| 1873 ..... | 1,456,497 | 548,553 | 1,488,171 | 4,020,812 | 42,853 | 17,611 |
| 1874 ..... | 1,808,935 | 322,515 | 2,011,547 | 4,196,629 | 164,979 | 15,092 |
| 1875 ..... | 1,876,286 | 351,177 | 2,415,704 | 4,523,019 | 221,884 | 11,208 |
| 1876 ..... | 2,104,282 | 431,904 | 2,431,523 | 5,287,665 | 298,086 | 17,335 |
| 1877 ..... | 2,028,764 | 262,390 | 2,459,789 | 5,007,368 | 354,950 | 8,374 |

The percentage of increase in the import of coal from 1862 to 1877 was 226·9 per cent, and from 1866 to 1877, 175·9 per cent; the import of lignite from 1866 to 1877 had increased from 100 to 713·9 per cent. The quantity of coal exported increased from 1862 to 1877 from 100 to 237·5 per cent; that of lignites decreased from 1866 to 1877 from 100 to 60·1 per cent.

The entire quantity of coal exported in 1877 was 5,007,368 metric tons (4,928,332 English tons), of which 1,888,558 metric tons (1,858,738 English tons) went to Holland, 635,302 metric tons (624,671 English tons) to France, 1,384,992 metric tons (1,363,163 English tons) to Austria, 226,663 metric tons (223,084 English tons) to Russia, 361,593 metric tons (355,888 English tons) to Switzerland, 144,293 metric tons (142,015 English tons) to Belgium, and the remainder taking its way by the North Sea and Baltic ports, viz.: 205,105 metric tons (201,866 English tons) by Bremen, 127,688 metric tons (125,672 English tons) by Hamburg, and only 12,052 metric tons (11,862 English tons) by the Baltic ports. Of the 354,950 metric tons (349,345 English tons) of coke the following were the principal items: 158,006 metric tons (155,511 English tons) went to France, 128,794 metric tons (126,760 English tons) to Belgium, 18,709 metric tons

(18,414 English tons) to Switzerland, 15,376 metric tons (15,133 English tons) to Austria.

The 2,028,764 metric tons (1,996,730 tons English) of coal imported into Germany during 1877 came for the greatest part from England. This applies, without doubt, to 1,085,865 metric tons (1,068,719 tons English), imported by the Baltic ports, 318,215 metric tons (313,190 tons English) by Hamburg, 23,878 metric tons (23,701 tons English) by Bremen, and 112,120 metric tons (110,350 tons English) by other North Sea ports; 300,939 metric tons (296,987 tons English) were imported from Austria (principally into Bavaria), and 85,846 metric tons (84,490 tons English) from France.

The quantity of lignite exported from Germany is not worth mentioning. Notwithstanding the considerable output, the quality of the lignite is not sufficiently good to pay the expenses of a lengthened transport. The import is so much larger, and the excellent lignites of North-Western Bohemia have the greatest share of it. Of the entire quantity of 2,459,789 metric tons imported during 1877, nearly all, viz., 2,455,090 metric tons, came from Austria.

A return of the consumption in the capital of Germany may be interesting. The city of Berlin consumed during 1877 :—

| | | |
|---|---|---|
| Of Upper Silesian Coal | 622,892 | Metric Tons. |
| „ Bohemian Lignite | 247,890 | „ |
| „ Ruhr District Coal | 81,945 | „ |
| „ Lower Silesian Coal | 69,992 | „ |
| „ Prussian Lignite | 68,976 | „ |
| „ English Coal | 17,880 | „ |
| „ Zwickau Coal | 5,641 | „ |
| Total | 1,110,216 | „ |

Or, 1·1 tons per head.

## PRESENT SITUATION AND FUTURE PROSPECTS.

The German coal trade is at present in a very unfavourable situation. Anyone doubting this will be convinced by a glance at our table of changes in the prices of coal; that for an object like coal a reduction in the price of more than one-half, brought about in the short space of three years, must be followed by the most injurious effects upon the return of the capital invested in the respective concerns, is obvious. In 1876 there was still a number of mines working at a little profit, but in 1877 nearly all mining companies worked at a loss, in spite of the reduction of wages to a minimum, and of marked improvements in the personal efficiency of the workmen, as well as of all technical appliances. For 1878 a further deterioration even in the state of trade is expected, and may be predicted with the utmost certainty, because the prices obtained for coal to be delivered during 1878 are frequently below the level of the past year.

This bad state of affairs may be explained by the fact that more coal is produced than there is wanted. In consequence of the general depression of trade, the consumption of coal has been greatly restricted during the last year in all works where steam is used; but, above all, it is the prostration of the iron trade (which in normal times consumes 29 per cent of the entire output of coal) by which the present unfavourable state of the coal trade is even aggravated to a dangerous crisis. A lasting improvement may only be expected after an improvement in the iron trade.

For the purpose of relieving the present excess, the coal-masters of several districts have agreed to reduce their production, in the first instance, by 6 per cent. Whether this measure, which is certainly a proof of the insight and the

good intention of the parties concerned, will be successful or not, remains to be seen. A lasting result can only be expected in the case of all coal-masters resolving to adopt the same measure, and if at the same time it could be guaranteed that the diminution of the output would not be balanced at a moment's notice by an increase of the import of English coal and of Bohemian lignite. As matters are, however, the over-production of coal is a fact; but if we consider that 5,000,000 metric tons (4,921,050 English tons) of coal are exported yearly, but that at the same time 2,000,000 metric tons (1,968,420 English tons) of foreign coal, and 2,450,000 metric tons (2,411,315 English tons) of Bohemian lignite (nearly approaching coal in heating value), or a total of 4,450,000 metric tons (4,379,734 English tons) of coal, is imported, our notions regarding over-production may be altered. According to this the German mines produced in 1877 the comparatively small quantity of 550,000 metric tons (541,316 English tons) in excess of the home demand, the latter being at the same time reduced to such a degree as has never been the case before. The reproach of over-production, accordingly, though frequently heard, should not be cast upon the German coal-masters, except with great caution, because a certain freedom of regulating the production according to the demand of the home market cannot be denied to any branch of industry.

However dark the present situation of the German coal trade is, its future prospects are very promising, and will improve as soon as the question of transport—which, though difficult, is yet solvable—is brought to a successful and satisfactory issue. It is sufficiently known how much the export of British coal by sea has contributed to the domineering position which Great Britain holds at present amongst the commercial nations of the world. If it could be the mission of any country to contest the supremacy of the English coal trade, this country would be Germany, because of her enormous coal deposits and her comparatively low cost of production. Great exertions will be required to accomplish this, and good results—not to say equality to the present English coal trade—may hardly be expected within the next ten or even twenty years. In the same degree, however, as English miners are obliged to descend to greater depths, and as the coal deposits most available for transport by sea—those of the northern counties of England, of Scotland, and Wales—are approaching exhaustion, the chances of the German coal trade will improve.

The most important question will be the cost at which German coal may be delivered at the North Sea and Baltic ports; and here it will be a proof of a just appreciation of the wants of German industry, commerce, and shipping, if German seaport towns are considered as outlets of even such districts as that of the Ruhr, in preference to the Dutch and Belgian ports, notwithstanding their better connection by way of the Rhine. Of all German coal districts the one best able to enforce this export is that of the Ruhr—taken in its entire extent up to Osnabrück and Minden—and eventually the Aix-la-Chapelle mines too, because these districts are the nearest to the sea. Railway tariffs must be reduced; if not, new lines for the special purpose of coal traffic, and, above all, canals, must be constructed. By these means the costs of carriage, which are far too high at present, will be brought down so far as to enable German coal to sustain the competition of its English rival. Further, if the Silesian coal districts were connected with the Baltic by a cheap waterway, by corrections in the course of the river Oder, and by new canals, it could hardly be questioned that a market for Silesian coal could be found in Denmark, Sweden, Norway, and the Baltic provinces of Russia, all of which are now provided with English coal.

Highly creditable efforts to facilitate the export of German coal have already been made by the Westfalian Export Association. The success of these exertions depends in the main upon the question—how far German shipowners, German railways, and, as far as regards new canals, also the German Government, are disposed to work hand in hand—a thing much to be desired.

## IRON.*

During the middle ages, from the end of the Crusades to the beginning of the Thirty Years' War, there existed in Germany an iron industry of comparatively fair extent. The use of iron however was greatly restricted, and the demand for it was very far from reaching the enormous quantities of the present time. The production was accordingly confined within narrow limits; but being of good quality, it was much asked for even in foreign countries. At that time the German Hansa was dominating the North Sea and Baltic ports, and monopolising the trade with England, Norway, Sweden, Denmark, and the Baltic provinces of Russia. Even French and Spanish ports were supplied with the products of German industry by this company, which encountered a powerful competition only in the Mediterranean on the part of the Italian mercantile towns. But the German shipping trade was based upon a native industry, which, in many respects, was decidedly ahead of the age. This may be said especially of the German iron industry, the highly advanced state of which is even now proved by the excellent finish of every description of metal work handed over to us from those times.

Considering these circumstances, as well as the abundance of coal and iron ores in Germany, it would seem to have been the natural destiny of that country to obtain the eminent rank in the iron trade, actually occupied at present by England. Even in the sixteenth century no German would have taken it to be possible that England, a country then supplied from Germany, would afterwards take the lead in the race. But the chief fault of the German industry in failing to maintain its position must be attributed to the ominous political discord of the German people, and to the petty separatistic interests of their rulers. Great Britain and France became consolidated empires, while the Germans continued to disagree, and remained disunited. This great country was forced to suffer its neighbours to fight out their quarrels on German soil, tearing at the same time one province after the other from the mother country, and destroying the prosperity of the inhabitants. The thirty years war alone has inflicted a terrible loss upon Germany. When peace was concluded at Osnabrück in 1648, the former flourishing state of agriculture, industry, and trade was utterly ruined, and Germany was a poor country, bleeding from a thousand wounds. The fruits of subsequent labour were again destroyed by the ensuing wars occasioned by the Spanish succession, the rivalry between Prussia and Austria and the French revolution; thus the accumulation of capital—an indispensable condition of modern industry—was made impossible.

The want of unity in commercial politics was another impediment to the growth of industry, its influence being as disastrous as the former. Only when in the year 1833 the association of German States, known by the name of "Zollverein," and effecting the introduction of a common import tariff, had been achieved, the iron trade began to revive again, a market for the productions of German ironworks being then secured on German soil. In consequence of the construction of railways, the increasing introduction of steam-power, and of the use of iron instead of wood and stone, and, lastly, of the general rise of commerce and traffic, the growth of this new-born industry was very rapid, as is shown by the production of pig-iron, which rose from hardly 100,000 metric tons (98,420 English tons) in 1830, and not more than 200,000 metric tons (196,842 English tons) in 1848, to 2,175,000 metric tons (2,140,657 English tons) in 1873—nearly

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* LITERATURE.—WEDDING: Handbuch der Eisenhüttenkunde. LINDHEIM: Kohle und Eisen. Publicationen des Vereins deutscher Eisen und Stahlindustrieller.
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ENGEL: Zeitschrift für Statistik des Preussischen Staates.

eleven times the amount of 1848. Besides this, we must not lose sight of the circumstance that the first and most essential conditions of an iron industry—sufficient capital, skilled labour, adequate means for transporting the raw materials, a settled demand, &c.—were, even in 1850, as good as non-existing, or, at the best, only in a most primitive and unsatisfactory state.

But the German iron industry would nevertheless have been entirely suppressed by the more extensive and far more favourably situated English competition, if protection by a moderate tariff had not been provided. This applies, in the first degree, to a duty on pig-iron of 20 marks (19s. 7d.) per metric ton (19s. 11¾d. per English ton), which, together with an increase in the import duties already existing on the most important descriptions of hardware, was introduced in 1846. The duties as fixed by the law of the 10th of October, 1845, have continued without change (some trifling reductions excepted) for nearly twenty years, and have been highly beneficial in their results. In the years 1865 and 1870 a reduction of the duties took place, but it was so slight that competition with England remained still possible. But the further reductions of 1873, when even the complete abolition of all duties on iron (only those on fine ironware excepted) was settled beforehand for 1876, has proved to be a very ominous measure—an over-hasty step, which will have to be retraced, if the existence of the German iron industry is not to be seriously imperilled.

The table on page 87 gives the import duties on iron, hardware, and machinery, consisting of iron and steel, for the years mentioned therein, per metric cwt. (=100 kilo.) in marks (=0·98s.)

It will be seen that the import duties on iron have been abolished since the beginning of 1877. Accordingly the German iron trade is at present under the necessity of entering into a mutually free competition with the more favourably situated ironworks of Great Britain, and to permit an unrestricted importation of iron and hardware from all other iron-producing countries (Belgium, France, Austria, the United States, &c.), while these countries at the same time choose to protect their native industries against German competition by more or less prohibitive tariffs. The German iron industry is of a comparatively recent date, and certainly not equal to this task, in spite of its unquestionable vitality, which will be apparent from the following remarks.

## IRON ORES.*

In the German empire 4,730,352 metric tons (4,655,661 English tons) of iron ores were raised during 1875, the number of mines being 1,026. Of this quantity 2,594,422 metric tons (2,553,456 English tons) were contributed by Prussia, 102,185 metric tons (100,571 English tons) by Bavaria, 131,216 metric tons (129,144 English tons) by Hesse, 758,208 metric tons (746,236 English tons) by Lorraine, 1,052,405 metric tons (1,035,787 English tons) by Luxemburg, and the remainder—consisting of smaller quantities—must be divided between Saxony, Würtemberg, and the Thuringian States.

Germany possesses an abundance of iron ores, and has some first-rate descrip-

* The grand duchy of Luxemburg (2587 square kilos., 198,752 inhabitants) was until 1866 a member of the German Confederation. From that time it has ceased to be so; but it has remained in the "Zollverein," and is consequently to be considered as a portion of Germany as far as commercial policy is concerned, although the government is in the hands of the Dutch. The mining statistics of the German empire give a separate return of the production, but not of the import and export of Luxemburg. Accordingly all the following returns relating to the change of production and prices, &c., of iron and steel are including Luxemburg too. The statistical office of the German Empire did not publish the mining statistics for 1876 before the beginning of April, 1878, and, as far as it was possible, the figures have been subsequently added during the passage of these pages through the press. Some special returns, however, which would have required a complete remodelling of the report, and consequently a considerable delay in its publication, have been omitted.

| | 1818 | 1846 | 1865 | 1868 | 1870 | 1873 | 1877 |
|---|---|---|---|---|---|---|---|
| For pig-iron | ... | 2·0 | 15·0 | 1·0 | 0·5 | ... | ... |
| „ forged and rolled bar-iron | 6·0 | 9·0 | 5·0 | 5·0 | 3·5 | 2·0 | ... |
| „ sectional iron | 6·0 | 18·0 | 7·0 | 7·0 | 5·0 | 2·0 | ... |
| „ angle, T, and channel-iron | 6·0 | 9·0 | 5·0 | 5·0 | 3·5 | 2·0 | ... |
| „ rails | ... | 9·0 | 5·0 | 5·0 | 3·5 | 2·0 | ... |
| „ fish and joint plates | ... | 36·0 | 8·0 | 8·0 | 8·0 | 5·0 | ... |
| „ steel | 6·0 | 9·0 | 5·0 | 5·0 | 3·5 | 2·0 | ... |
| „ anchors and anchor chains, and cables | 6·0 | 18·0 | 7·0 | 7·0 | 5·0 | 2·0 | ... |
| „ plates and sheets | 13·5 | 18·0 | 7·0 | 7·0 | 5·0 | 2·0 | ... |
| „ iron and steel sheets, polished and varnished | 13·5 | 24·0 | 10·5 | 10·5 | 7·0 | 2·0 | ... |
| „ tin plate | 24·0 | 24·0 | 15·0 | 15·0 | 7·0 | 2·0 | ... |
| „ iron and steel wire | 15·0 | 24·0 | 5·0 / 7·0 | 7·0 | 3·5 / 5·0 | 2·0 | ... |
| „ engine forgings | ... | 18·0 | 5·0 | 5·0 | 3·5 | 2·0 | ... |
| „ wrought-iron tubes | ... | 18·0 | 15·0 | 15·0 | 8·0 | 5·0 | ... |
| „ heavy cast-iron hardware, as stoves, plates, railings, pipes, &c. | 6·0 | 6·0 | 2·4 | 2·4 | 2·4 | 2·0 | ... |
| „ heavy wrought-iron and steel ware, as bridges (entire or in parts), roofings, and other constructions | 6·0 | 7·0 | 5·0 | 5·0 | 3·5 | 2·0 | ... |
| „ railway axles and tyres, wheels, buffers, &c. | ... | 36·0 | 8·0 | 8·0 | 3·5 / 8·0 | 2·0 / 5·0 | ... |
| COMMON HARDWARE. | | | | | | | |
| (*a*) For anvils, vices, winches, wire ropes, wire nails, ploughshares, carriage springs, skids, horse-shoes, &c. | 36·0 | 36·0 | 8·0 | 8·0 | 8·0 | 5·0 | ... |
| (*b*) For castings, varnished and ground, but not polished; wirework, pans, pots, chains, nails, rings, nuts, bolts, axles, small castings for locks and doors, railway springs, common plateware, common iron furniture, &c. | 36·0 | 36·0 | 8·0 | 8·0 | 8·0 | 5·0 | ... |
| (*c*) For all objects under (*a*) and (*b*) coppered, tinned, galvanized, or enamelled; hammers, locks, blades, scythes, sickles, clocks, screws, &c. | 36·0 | 36·0 | 16·0 | 8·0 / 16·0 | 8·0 | 5·0 | ... |
| (*d*) For swords, files, plane-irons, shears, saws, drills, straw-cutting blades, all sorts of tools made from steel, &c. | 36·0 | 36·0 | 16·0 | 16·0 | 8·0 | 5·0 | ... |
| FINE IRONWARE. | | | | | | | |
| (*e*) For fine and art castings, japanned ironware, knives, knitting and crotchet-needles, scissors, armoury, &c. | 60·0 | 36·0 | 24·0 | 24·0 | 24·0 | 24·0 | 24·0 |
| (*f*) For needles, steel pens, watch cases and movements, guns, &c. | 60·0 | 60·0 | 60·0 | 60·0 | 60·0 | 60·0 | 60·0 |
| For locomotive engines, tenders, & boilers | ... | ... | 9·0 | 9·0 | 9·0 | 4·0 | ... |
| „ machinery, consisting chiefly of wood | ... | ... | 3·0 | 3·0 | 3·0 | 2·0 | ... |
| „ „ „ cast-iron | ... | ... | 3·0 | 3·0 | 3·0 | 2·0 | ... |
| „ „ „ wrought-iron or steel | ... | ... | 5·0 | 5·0 | 5·0 | 2·0 | ... |
| Iron sea-going vessels | ... | ... | 8 p. c. | 8 p. c. | 8 p. c. | ... | ... |
| „ river-going vessels | ... | ... | 8 p. c. | 8 p. c. | 8 p. c. | 8 p. c. | 8 p. c. |

tions of them. *Brown ores* are the most prominent, being about 35 per cent of the entire output. They are found in Rhineland, Silesia, Luxemburg, Bavaria, Thuringia, Lorraine, Saxony, and Hanover. The *spathic ores* of Rhineland, Westfalia, the Siegen district, Thuringia, and Würtemberg are next in order, being 25 per cent; then comes the "*Blackband*" of Westfalia and Rhineland, the Saar district and Silesia, which is 18 per cent; next the *red ores* (oxides) of Wetzlar, the Siegen district, Nassau, Thuringia, Saxony, Bavaria, and Hesse, with 10 per cent of the whole output. The remainder may be divided amongst the *clay ironstone* of Rhineland, Westfalia, Silesia, Bavaria, Luxemburg, and German Lorraine, the *bog ores* of the low plains of northern Germany, and the *magnetic ore*—which is widely dispersed, but seldom found in deposits of considerable magnitude.

Although Germany is not behind other countries in regard to the quantity and quality of available iron ores, the position of her ore deposits is very disadvantageous, as only a few of them are in the vicinity of the coalfields, and some of the most extensive and important rather too far distant—as for example, the Nassau and Siegen districts, the ore beds of Hesse, Thuringia, Lorraine, Luxemburg, Bavaria, Würtemberg, &c. Another disadvantage, which has lately been more seriously felt than before, is occasioned by the comparative scarcity of ores free from phosphorus and suitable for Bessemer pig-iron. In consequence of this, the German steelworks are obliged to draw from 40 to 50 per cent of their supplies of Bessemer ores from abroad—from Elba, Algeria, Spain, Sweden, Galicia—by a lengthy and very expensive transport.

In *ironstone mining* were engaged:—

| | | | | |
|---|---|---|---|---|
| In 1848..... | 1,974 | mines and | 15,610 | workmen. |
| „ 1853..... | 1,878 | „ | 18,028 | „ |
| „ 1857..... | 3,015 | „ | 28,424 | „ |
| „ 1872..... | 1,341 | „ | 39,421 | „ |
| „ 1875..... | 1,026 | „ | 28,138 | „ |

The *entire output of iron ores* was:—

| Year. | Metric Tons. | Value in £ Sterling. | Year. | Metric Tons. | Value in £ Sterling. |
|---|---|---|---|---|---|
| 1848 | 693,725 | 187,417 | 1870 | 3,839,222 | 1,179,145 |
| 1853 | 903,236 | 245,625 | 1871 | 4,368,025 | 1,506,061 |
| 1857 | 1,962,054 | 569,881 | 1872 | 5,895,674 | 2,071,981 |
| 1862 | 2,216,021 | 528,268 | 1873 | 6,177,576 | 2,119,895 |
| 1866 | 2,996,021 | 838,357 | 1874 | 5,137,468 | 1,398,274 |
| 1867 | 3,264,464 | 898,466 | 1875 | 4,730,353 | 1,308,245 |
| 1868 | 3,634,369 | 948,087 | 1876 | 4,711,982 | 1,155,194 |
| 1869 | 4,033,807 | 1,137,877 | | | |

Accordingly between 1848 and 1875 the weight of the entire output increased from 100 to 681·9; the value from 100 to 698·1 %. The maximum, at a figure of 6,177,576 metric tons (6,080,032 English tons), was reached in 1873; it decreased in the following year by 1,040,000 metric tons (1,023,578 English tons), and until 1876 to 426,000 metric tons (419,273 English tons) more. The quantities of ore raised on an average by each individual miner were 444 metric cwt. (43·6 English tons) in the year 1848, and 1,681 metric cwt. (165 English tons) in 1875.

The *foreign trade in iron ores* shows the following figures:—

| Year. | Import. | Export. | Year. | Import. | Export. |
|---|---|---|---|---|---|
| | Metric Tons. | | | Metric Tons. | |
| 1862 | 35,488 | 102,690 | 1872 | 382,536 | 111,719 |
| 1866 | 106,488 | 183,821 | 1873 | 460,509 | 104,668 |
| 1867 | 157,813 | 207,892 | 1874 | 48,031 | 316,352 |
| 1868 | 161,558 | 30,062 | 1875 | 220,916 | 606,925 |
| 1869 | 242,939 | 431,852 | 1876 | 197,537 | 670,882 |
| 1870 | 300,108 | 84,275 | 1877 | 328,184 | 804,037 |
| 1871 | 270,176 | 517,354 | | | |

Of the *ores imported* during 1877 a quantity of 237,441 metric tons (233,691 English tons) came from Holland—being most likely foreign Bessemer ore shipped to Dutch ports. According to all appearance 43,318 metric tons (42,634 English tons) of the same description came from Austria, 7,375 metric tons (7,258 English tons) from Russia; and perhaps the entire quantity of imported ores will be represented by the figure of 328,184 metric tons (323,002 English tons).

The considerable increase of the *ores exported* during the last years (between 1873 and 1877 from 104,500 to 804,000 metric tons) is a convincing proof of the present unfavourable position of the German ironworks, if we take into account that in the very same year 1877 a quantity of 526,708 metric tons (518,391 English tons) of foreign pig-iron crossed the German frontiers by way of import and transit. The principal item of the ore export is 800,036 metric tons (787,403 English tons) sent to Belgium, and raised most likely in Luxemburg. Under other circumstances the German ironmasters would certainly have preferred either sending the contents of the ores abroad in a manufactured state, and at a price increased by labour and the return of the capital invested in works, or to use them for supplying the home demand for manufactured iron, than to sell the ores as such.

## PIG-IRON.

The German *blast furnaces* are, on the average, producing one ton of pig-iron from 2·5 to 2·8 tons of ore, according to quality, by means of 2·8 to 3·2 tons of coal or coke, and of 1 to 1·5 tons of limestone flux, or of a total quantity of raw material of 6·3 to 7·5 tons. These materials are unfortunately less frequently found together in Germany than in many other iron-producing countries; but as the weight of fuel is exceeding that of the ores, the situation of new works in Germany is selected with a view of transporting the ores to the coalfields rather than the greater quantities of fuel to the ore deposits. At all events, it is a question of *carriage*, or of that item in the cost of production, which in Germany is running exceptionally high, owing to the scarcity of efficient waterways, and to unreasonably high railway tariffs.

The *prices of the raw materials* (ore, coal, and limestone flux) at the *pit mouth* are not likely to be greatly different in Germany, England, and Belgium. For foundry and Bessemer pig-iron they may be a little cheaper in England, but for common forge pig-iron they are nearly equal in those countries, and for the best brands of this description some German works may have a slight advantage. German ironworks, however, are at a decided disadvantage as regards the *costs of carrying* the ore, coal, and flux from the mine to the works. The following *average costs of carriage to the works for the ore, coal, and flux required for one metric ton of pig-iron* are taken from a compilation made by the Association of German Iron and Steel Works at the beginning of 1877:—

| | Foundry Pig-iron. | Forge Pig-iron. | White (1st Class) Pig-iron. | Bessemer Pig-iron. |
|---|---|---|---|---|
| | s. d. | s. d. | s. d. | £ s. d. |
| England | 10 6 | 10 6 | 14 5 | 0 14 9 |
| Rhineland and Westfalia | 18 0 | 19 0 | 18 0 | 1 5 8 |
| Upper Silesia | 15 3 | 14 9 | ..... | 1 0 7 |

According to this table, the differences of freight per metric ton of foundry pig-iron were 5s. to 7s. 9d.; of forge pig-iron, 4s. 6d. to 8s. 9d.; of first-class white pig-iron, 3s. 8d.; and of Bessemer pig-iron, 6s. 3d. to 11s. 3d.

The exceptionally great difference in Bessemer pig-iron is owing to the high cost of carrying the ores from foreign countries to the works, which for the greatest part are remote from the sea-coast.

The following are the *average total prime costs of one metric ton of pig-iron* for June, 1877, resulting from very careful calculations, and comprising the cost of the raw materials delivered at the works, the wages, &c., the contributions to the sinking fund, interest on preference and bankers' loans, &c., &c. :—

| | Forge Pig-iron. | | Foundry Pig-iron. | | Bessemer Pig-iron. | |
|---|---|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| England | 1 18 2 | to 2 3 1 | 2 4 0 | to 2 11 0 | 2 18 10 | to 3 0 9 |
| Rhineland and Westfalia | 2 9 0 | to 2 19 9 | 3 1 9 | to 3 8 7 | 3 10 7 | to 4 7 4 |
| Silesia | 2 11 0 | to 2 13 11 | 3 2 9 | to 3 7 7 | 3 9 7 | to 3 16 5 |

In this connection it should be borne in mind that Rhenish, Westfalian, and Silesian pig-iron, being of better quality than many English brands, is able to command a higher price in the German market, which, however, may not always be fully realised in times of depression. Besides, a few works in an exceptionally favourable situation are found which are producing at a rate below these average figures, and are approaching more the standard of the English works, but, taken on the whole, the German iron trade is at a decided disadvantage as compared with the competing countries as to prime costs, and principally as to freights.

The *production* of *pig-iron* (without castings) of the entire German empire (Luxemburg included) was as follows :—

| Year. | Metric Tons. | Value in £ sterling. | Year. | Metric Tons. | Value in £ sterling |
|---|---|---|---|---|---|
| 1848 | 205,342 | 1,203,214 | 1870 | 1,345,520 | 4,788,278 |
| 1853 | 305,761 | 1,756,538 | 1871 | 1,491,477 | 5,444,838 |
| 1862 | 524,591 | 3,287,447 | 1872 | 1,927,061 | 10,231,904 |
| 1865 | 645,693 | 2,573,540 | 1873 | 2,174,058 | 11,445,597 |
| 1866 | 996,738 | 3,764,155 | 1874 | 1,856,311 | 7,364,645 |
| 1867 | 987,163 | 3,520,841 | 1875 | 1,931,736 | 6,887,730 |
| 1868 | 1,200,188 | 4,094,199 | 1876 | 1,801,457 | 5,477,577 |
| 1869 | 1,356,965 | 4,613,848 | | | |

The percentage of increase (the initial figures of each period being taken = 100) was :—

| | According to Weight. | | According to Value. |
|---|---|---|---|
| From 1848 to 1868 ..... | 584·4 % | ..... | 340·0 % |
| From 1868 to 1875 ..... | 165·1 „ | ..... | 168·2 „ |
| From 1848 to 1875 ..... | 965·0 „ | ..... | 572·4 „ |

As Alsace and Lorraine, with an average annual production of 235,000 metric tons (231,289 English tons), form since 1871 parts of the German empire, and as Luxemburg, with an annual production of 270,000 metric tons (265,736 English tons), has ceased to be so, a more correct notion of the percentage of increase may be obtained from the following table.

The *total production of pig-iron and castings from the blast furnaces was as follows :—*

| During the Year. | In the German Empire. Without Alsace-Lorraine. Metric Tons. | In the German Empire. With Alsace-Lorraine. Metric Tons. | In the German Empire. Alsace-Lorraine and Luxemburg included. Metric Tons. |
|---|---|---|---|
| 1867 | 1,034,300 = 100 % | 1,034,300 = 100 % | 1,113,606 = 100 % |
| 1868 | 1,158,439 = 112·5 „ | 1,158,939 = 112·5 „ | 1,264,347 = 113·5 „ |
| 1869 | 1,288,990 = 125·1 „ | 1,288,990 = 125·1 „ | 1,413,029 = 126·8 „ |
| 1870 | 1,261,683 = 122·3 „ | 1,261,683 = 122·3 „ | 1,391,124 = 125·2 „ |
| 1871 | 1,420,830 = 137·3 „ | 1,420,830 = 137·8 „ | 1,563,682 = 140·5 „ |
| 1872 | 1,585,776 = 153·3 „ | 1,807,846 = 175·2 „ | 1,988,395 = 178·8 „ |
| 1873 | 1,712,695 = 165·6 „ | 1,983,163 = 192·2 „ | 2,240,575 = 201·8 „ |
| 1874 | 1,408,789 = 136·2 „ | 1,660,209 = 161·1 „ | 1,906,263 = 171·6 „ |
| 1875 | 1,521,126 = 147·0 „ | 1,759,052 = 170·3 „ | 2,029,389 = 182·4 „ |
| 1876 | 1,416,408 = 136·9 „ | 1,614,687 = 156·1 „ | 1,846,345 = 165·8 „ |

Of the total production of the empire, an average of 68·9 per cent is due to Prussia, where

| | | | | |
|---|---|---|---|---|
| In 1874 were produced | | 1,280,269 | metric tons | of pig-iron. |
| In 1875 | „ | 1,398,337 | „ | „ |
| In 1876 | „ | 1,324,339 | „ | „ |
| In 1877 | „ | 1,421,032 | „ | „ |

The *number of blast furnaces* existing in the different countries and provinces was as follows :—

| | Furnaces. In Blast. | Furnaces. Out of Blast. | | Furnaces. In Blast. | Furnaces. Out of Blast |
|---|---|---|---|---|---|
| PRUSSIA. | | | | | |
| Silesia | 44 | 41 | Brought forward | 229 | 143 |
| Saxony | 2 | ... | Würtemberg | 5 | ... |
| Hanover | 10 | 4 | Hesse | 5 | ... |
| Westfalia | 48 | 32 | Brunswick | 7 | 3 |
| Hesse and Nassau | 22 | 7 | Meiningen | 1 | 1 |
| Rhineland | 83 | 43 | Anhalt | 1 | ... |
| Hohenzollern | ... | 2 | Waldeck | 1 | ... |
| | | | Reuss | 1 | ... |
| Total | 209 | 129 | Alsace | ... | ... |
| Bavaria | 15 | 8 | Lorraine | 26 | 11 |
| Kingdom of Saxony | 5 | 6 | Luxemburg | 21 | 8 |
| Carried forward | 229 | 143 | Total empire | 297 | 166 |

Of the 297 furnaces in blast, 198 were using coal or coke, 86 charcoal, and 13 a mixture of both.

In 1848 the number of workpeople employed at the blast furnaces was 13,823; in 1857, 19,483; in 1875, 22,760 (22,082 males and 678 females). In 1848, 149 metric cwt. (14·4 English tons), in 1857, 155 metric cwt. (15·2 English tons), and in 1875, 812 metric cwt. (79·9 English tons) of pig-iron were produced per head of workpeople.

With regard to the *pig-iron market* it is to be noticed that the most important districts of production have sprung up in or near the coal districts, and are accordingly situated close to the frontiers of the empire. This applies to Upper Silesia, Lorraine, Luxemburg, the Saar district, the Saxon and Bavarian furnaces, and in some degree also to the most important district—that of Rhineland and Westfalia. Only the smaller works in the Harz mountains, some furnaces in the provinces of Hanover and Hesse, Nassau, and in Würtemberg, are in a more central location. Consequently the greater number of the works are unfavourably situated with regard to the facilities for disposing of their produce within German territory, and this disadvantage is of great importance, as the rates of freights too are in many cases decidedly favourable to the foreign competition. The German works are almost entirely confined to the use of the railways for the purpose of getting rid of their produce. The English competition has not only the advantage of low sea freights, but that of the cheap transport on German rivers besides; and it is thus enabled to penetrate into the very centre of Germany by way of the Rhine, Elbe, Oder, and Vistula. The following rates of freight per metric ton of iron and hardware were paid in the spring of 1877:—

| | s. | d. |
|---|---|---|
| 1. From the English coast, *via* Stettin, to Berlin | 13 | 8 |
| „ Rhineland (Oberhausen) „ | 15 | 2 |
| „ Upper Silesia (Königshütte) „ | 13 | 11 |
| 2. From Scotland, *via* Stettin „ | 15 | 2 |
| „ Rhineland (Oberhausen) „ | 15 | 2 |
| „ Upper Silesia (Königshütte) „ | 13 | 11 |
| 3. From the English coast, *via* Hamburg and Magdeburg, to Dresden | 16 | 2 |
| „ Rhineland (Oberhausen) to Dresden | 19 | 2 |
| „ Upper Silesia (Königshütte) „ | 17 | 5 |
| 4. From England, *via* Stettin, to Frankfurt-on-the-Oder | 11 | 7 |
| „ Rhineland (Oberhausen) „ „ | 16 | 10 |
| „ Upper Silesia (Königshütte) „ „ | 12 | 6 |

5. The freight from the eastern coasts of England and Scotland to Holland was 6s. 6d. per metric ton; from there to Cologne, 3s. 11d. at the utmost; to Mayence, 4s. 11d. to 5s. 5d.: thus permitting English and Scotch ironware to be transported across the most important district of German iron manufacture at the rate of 10s. 6d. per metric ton, or at a lower rate than the amount of the difference in the prime costs.

Owing to these circumstances the German iron trade was, after the abolition of the import duties, only able to maintain the home market by ruinous prices, while at the same time it endeavoured to obtain some compensation abroad for the loss sustained at home. According to the statistical returns, *the export of pig-iron* has considerably increased during the last years; but as those returns also include quantities entered for transit only, they ought to be accepted with some caution. Of the total quantity exported in 1877, amounting to 344,019 metric tons (338,587 English tons), 247,660 metric tons (243,749 English tons) have been sent to or by way of Belgium, 29,174 metric tons (28,713 English tons) to Austria, 11,334 metric tons (11,155 English tons) to Switzerland, 12,006 metric tons

(11,816 English tons) to Russia, and 23,837 metric tons (23,461 English tons) to or by way of the Netherlands.*

The quantities of pig and scrap iron imported and exported are as follow :—

| Year. | Import. | | Export. | |
|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. |
| 1862 ..... | 152,815 | | 13,127 | |
| 1866 ..... ..... | 140,469 | | 20,606 | |
| 1867 ..... | 116,911 | | 29,613 | |
| 1868 ... ..... | 132,525 | Scrap-iron included. | 98,019 | Scrap-iron included. |
| 1869 ..... | 189,746 | | 101,857 | |
| 1870 ..... | 229,334 | | 109,825 | |
| 1871 ..... | 440,455 | | 111,701 | |
| | Pig-iron. | Scrap-iron. | Pig-iron. | Scrap-iron. |
| 1872 ..... | 619,756 | 42,819 | 124,318 | 25,131 |
| 1873 ..... | 690,489 | 52,578 | 135,417 | 18,049 |
| 1874 ..... | 531,474 | 17,560 | 207,105 | 15,138 |
| 1875 ..... | 606,379 | 18,235 | 322,223 | 16,767 |
| 1876 ..... | 571,134 | 12,520 | 289,417 | 16,783 |
| 1877 ..... | 526,708 | 14,225 | 344,019 | 19,915 |

The greatest portion of the imported pig-iron comes from Great Britain. Of the entire quantity of 526,708 metric tons (518,708 English tons) for 1877, the following items may safely be taken as being British iron : 73,293 metric tons (72,136 English tons) imported by the Baltic ports ; 215,772 metric tons (212,365 English tons) from Holland ; 7,190 metric tons (7,076 English tons) by Bremen ; 87,697 metric tons (86,312 English tons) by Hamburg ; and 9,043 metric tons (8,900 English tons) by other North Sea ports. This may partly apply as well to 90,240 metric tons (97,673 English tons) imported from Belgium, considerable quantities for German demand being shipped to Antwerp.

## STEEL.

Until the year 1856 only two steelworks existed in Germany : the well-known Essen and Bochum works, noted for their display at all international exhibitions. The extraordinary productions of Mr. KRUPP'S works at Essen were commanding even the respect of the English ironmasters. When Mr. BESSEMER'S far-famed invention began to enter into competition with the manufacture of crucible steel, when Messrs. SIEMENS and MARTIN applied the regenerative principle invented by the former gentleman to the production of cast-steel, the steel-works were obliged to adopt these important innovations in order to secure their own existence. As soon as it had been recognised that iron—at least in its application to railway purposes—would be entirely supplanted by the more durable Bessemer steel, the ironmasters, willingly or unwillingly, were compelled to apply themselves to steel manufacturing. The inconvenience of this state of transition was most acutely felt in Germany, as owing to the scarcity of suitable native ores large quantities of foreign ores had to be purchased abroad, and to be carried into the country at exorbitant freights. But if German industry was not

* The figures for Belgium and the Netherlands can hardly be considered as quantities really exported. It frequently happens that, owing to the high railway tariffs, Rhenish and Westfalian pig-iron, which has been sold to the eastern provinces of Prussia, is sent to Antwerp and Rotterdam, and shipped from there to the Baltic ports. The same is frequently the case with pig-iron for Poland and Russia. Thus the same item of pig-iron may be set down by the German custom-house officials at the Dutch frontier as export, and in Dantzic or Königsberg as import. It even happens that such items are set down at the above-named frontiers as export, in the Prussian Baltic ports as import, and when crossing the Russian frontier again as export—for instance, 5,000 tons of pig or any other description of iron, or hardware, actually manufactured and sold, thus figuring at the same time as 10,000 tons exported and 5,000 tons imported.

to lag behind or to go to ruin altogether no choice was left but to make use of this invention at any price. Accordingly since 1865 new Bessemer works have been erected in rapid succession at Hörde, Oberhausen, Ruhrort, Dortmund, Osnabrück, near Aix-la-Chapelle, at Königshütte (Upper Silesia), in Bavaria, and in Saxony. The progress made by the German steel industry, from a technical point of view, within a comparatively short time, is highly satisfactory; the steel manufacturers having succeeded in reducing by degrees the requisite admixture of foreign ore without impairing the quality of the steel produced, which is held in good repute even in foreign countries; but they have been suffering greatly, not only from the general unsatisfactory state of business existing since 1873, but even more from the abolition of the import duties, which in consequence of the universal over-production were more indispensable than ever.

The rapid increase of the production is shown by the following table :—

| Year. | Production in Metric Tons. | Value in £ Sterling. | Year. | Production in Metric Tons. | Value in £ Sterling. |
|---|---|---|---|---|---|
| 1848 | 9,024 | 122,168 | 1871 | 250,947 | 4,276,131 |
| 1862 | 40,916 | 906,888 | 1872 | 312,247 | 5,056,501 |
| 1866 | 114,434 | 2,833,193 | 1873 | 302,647 | 4,888,243 |
| 1867 | 122,591 | 2,848,316 | 1874 | 354,256 | 4,547,432 |
| 1868 | 122,837 | 2,818,885 | 1875 | 352,431 | 3,735,224 |
| 1869 | 161,319 | 3,323,753 | 1876 | 390,434 | 3,656,864 |
| 1870 | 169,951 | 3,337,077 | | | |

The percentage of increase (the initial figures of each period being taken =100) was as follows :—

| | According to Weight. | According to Value. |
|---|---|---|
| From 1848 to 1868 ..... | 1365% ..... | 2307·6% |
| „ 1868 to 1875 ..... | 286·8% ..... | 132·4% |
| „ 1848 to 1875 ..... | 3916·1% ..... | 3057·8% |

The portion of the production due to the kingdom of Prussia is as follows :—

In 1875.....333,640 metric tons of steel and steel manufactures.
„ 1876.....396,958 „ „ raw steel.
„ 1877.....443,347 „ „ „

The number of people employed in the steelworks was: 1,332 in 1848, 3,042 in 1857, and 19,509 in 1875.

In 1877 there existed eighty-one Bessemer converters, of which, however, only thirty-nine were working, and even those not throughout the entire year.

The quantity of *steel manufactures* of every description (rails, fish-plates, railway axles and wheels, engine-pieces, sheets and plates, wire, cannon and projectiles) was as follows :—

| | Metric Tons. | | | Metric Tons. |
|---|---|---|---|---|
| In the year 1872..... | 285,582 | ... | In the year 1875..... | 347,337 |
| „ 1873..... | 310,425 | ... | „ 1876..... | 377,910 |
| „ 1874..... | 361,947 | ... | | |

The quantities of *steel imported* and *exported* were :—

| | Import. | Export. | | Import. | Export. |
|---|---|---|---|---|---|
| Year. | Metric Tons. | | Year. | Metric Tons. | |
| 1862 ..... | 3,035 | 1,749 | 1872..... | 5,417 | 8,689 |
| 1866 ..... | 2,364 | 3,476 | 1873..... | 6,221 | 5,519 |
| 1867 ..... | 2,300 | 5,164 | 1874..... | 5,291 | 8,494 |
| 1868 ..... | 2,376 | 6,987 | 1875..... | 5,489 | 10,586 |
| 1869 ..... | 2,887 | 7,158 | 1876 ..... | 3,946 | 17,792 |
| 1870 .. ..... | 2,051 | 8,404 | 1877..... | 5,622 | 16,145 |
| 1871 ..... | 2,836 | 5,857 | | | |

## IRON CASTINGS.

The number of *iron foundries* was :—

| | | | | | | |
|---|---|---|---|---|---|---|
| In the year | 1848, | 109 | works, | giving employment to | 5,112 | workmen. |
| „ | 1853, | 133 | „ | „ | 8,439 | „ |
| „ | 1857, | 195 | „ | „ | 10,537 | „ |
| „ | 1872, | 772 | „ | „ | 39,934 | „ |
| „ | 1875, | 874 | „ | „ | 42,134 | „ |
| „ | 1876, | 867 | „ | „ | 35,291 | „ |

The foundries are nearly equally dispersed all over the country—the number in the iron districts of Rhineland, Westfalia, Upper Silesia, &c., being but little greater than for the other parts of the country.

The quantity of pig-iron, &c., used by 874 foundries, and 429 other (engineering, &c.) works, and melted in 1566 cupolas and 113 air-furnaces, was as follows in 1875 :—

| Metric tons of iron used. | | | Metric tons of castings produced. | | |
|---|---|---|---|---|---|
| 116,102 | tons | German pig-iron, | 205,365 | tons | machine castings. |
| 311,013 | „ | Foreign „ | 204,577 | „ | other castings. |
| 120,465 | „ | Scrap-iron, | 11,215 | „ | chilled castings. |
| | | | 60,332 | „ | own demand of the works. |
| 547,580 | „ | of pig-iron for | 481,489 | „ | of castings. |

Accordingly about 57 per cent of the entire quantity of of pig-iron, &c., used was purchased from abroad.

The German ironfounders are the best foreign customers in the English and Scotch pig-iron market; the native foundry pig-iron being higher in price, although generally of higher quality. Formerly an opinion prevailed that German pig-iron was wanting in uniformity of quality, and consequently less suitable for certain descriptions of castings constantly recurring. But the manufacture of German foundry iron has been decidedly improved of late, and it was demonstrated by extensive trials, made in Rhineland-Westfalia, by order of the Prussian Minister of Trade, during 1877, that it may now be safely applied to any purpose.

The *production of the foundries* was :—

| In the Year. | Castings Made from | | | | Total of Castings. | |
|---|---|---|---|---|---|---|
| | The Ore. | | Pig-iron. | | | |
| | Metric Tons. | Value in £ Sterling. | Metric Tons. | Value in £ Sterling. | Metric Tons. | Value in £ Sterling. |
| 1848 | ..... | ..... | ..... | ..... | 31,356 | 461,500 |
| 1853 | ..... | ..... | ..... | ..... | 66,347 | 924,089 |
| 1857 | ..... | ..... | ..... | ..... | 112,654 | 1,458,790 |
| 1862 | 50,657 | 482,954 | 131,929 | 1,423,137 | 182,586 | 1,906,091 |
| 1866 | 50,216 | 449,790 | 175,948 | 1,868,039 | 226,164 | 2,317,829 |
| 1867 | 126,444 | 617,755 | 189,000 | 1,915,327 | 315,444 | 2,533,082 |
| 1868 | 64,160 | 448,912 | 202,171 | 2,007,808 | 266,331 | 2,456,720 |
| 1869 | 56,065 | 508,395 | 239,900 | 2,402,180 | 295,965 | 2,910,575 |
| 1870 | 45,604 | 412,957 | 235,430 | 2,376,004 | 281,034 | 2,788,961 |
| 1871 | 72,205 | 763,363 | 346,935 | 3,320,605 | 419,140 | 4,083,968 |
| 1872 | 61,333 | 640,630 | 492,109 | 6,146,950 | 553,442 | 6,787,580 |
| 1873 | 66,516 | 711,664 | 524,137 | 6,686,419 | 590,653 | 7,398,083 |
| 1874 | 49,951 | 514,212 | 488,306 | 5,451,543 | 538,257 | 5,965,755 |
| 1875 | 47,654 | 475,666 | 484,639 | 5,240,154 | 532,293 | 5,715,820 |
| 1876 | 44,887 | 440,027 | 436,104 | 4,345,903 | 480,991 | 4,785,930 |

The percentage of the increase (the initial figures of each period being = 100) was :—

| | According to Weight. Per cent. | | According to Value. Per cent. |
|---|---|---|---|
| From 1848 to 1868 ..... | 849·6 | ..... | 532·4 |
| „ 1868 to 1875 ..... | 199·9 | ..... | 532·6 |
| „ 1848 to 1875 ..... | 1697·9 | ..... | 1238·5 |

The *import and export of castings* have been officially returned, but, as the classification has been repeatedly altered, the different periods admit of no comparison. The following table is confined to the last years.

| | Import. | | Export. | |
|---|---|---|---|---|
| | Metric Tons. 1876. | Metric Tons. 1877. | Metric Tons. 1876. | Metric Tons. 1877. |
| Heavy Castings ..... | 23,698 | 17,898 | 84,109 | 118,443 |
| Common Hardware of Iron or Steel, forged or cast ... | 11,593 | 31,378 | | |

A considerable proportion of the hardware export mentioned consists of *smallware*, which for ages has been manufactured in a most extensive way in Rhineland-Westfalia, (Remscheid, Hagen, Witten, Lüdenscheid, Iserlohn, Altena, &c.) Enormous quantities of castings and still more of wrought-iron hardware are manufactured here and sent to every part of the globe, as anvils, axes, hammers, hoes, chains, nails, rings, scythes, plate, and wire work, agricultural implements, and tools of every description.

## FORGED AND ROLLED IRON, RAILS, PLATES, SHEETS, AND WIRE.

The following number of furnaces, &c., producing *wrought-iron* were at work during 1875 :—

| | Puddling Furnaces. | Open Fires. | | Puddling Furnaces. | Open Fires. |
|---|---|---|---|---|---|
| Kingdom of Prussia ..... | 1,382 | 70 | Brought forward... | 1,484 | 106 |
| | | | Baden ..... | ... | 5 |
| Of these, in Silesia ..... | 375 | 16 | Hesse ..... | ... | 2 |
| „ Saxony ..... | 22 | ... | Brunswick ..... | 6 | ... |
| „ Westfalia ..... | 469 | 17 | Meiningen ..... | 1 | ... |
| „ Hesse-Nassau... | 22 | 8 | Anhalt..... | ... | 2 |
| „ Rhineland ..... | 486 | 23 | Waldeck ..... | ... | 1 |
| | | | Alsace-Lorraine..... | 106 | 9 |
| Kingdom of Bavaria..... | 70 | 16 | Luxemburg..... | 5 | ... |
| „ Saxony ..... | 13 | 6 | | | |
| „ Würtemberg... | 5 | 14 | | | |
| „ Oldenburg .... | 14 | ... | | | |
| Carried forward..... | 1,484 | 106 | German Empire..... | 1,602 | 125 |

Apart from these, there are returned by the Statistical Office to be actually at work—

At the cast-steel works..... 271 puddling furnaces and 2 open fires.
„ raw and German steel works.. 85 „ „ 18 „

The quantity of *bar-iron*, inclusive of *rails, plates, and sheets, wire, sectional iron, bridge work, forgings, tubes, &c.*, produced in 1875, was :—

| Year. | Metric Tons. | Value in £ Sterling. | Year. | Metric Tons. | Value in £ Sterling. |
|---|---|---|---|---|---|
| 1848 | 164,752 | 2,364,652 | 1872 | 1,179,794 | 15,605,298 |
| 1857 | 402,136 | 6,267,469 | 1873 | 1,182,502 | 15,484,075 |
| 1867 | 641,523 | 6,294,273 | 1874 | 1,207,419 | 12,093,738 |
| 1869 | 751,467 | 7,458,876 | 1875 | 1,102,813 | 9,180,695 |
| 1871 | 886,074 | 8,729,416 | 1876 | 1,017,747 | 7,447,185 |
| | 1,012,769 | 10,581,317 | | | |

According to this, the percentage of increase was :—

| | According to weight. Per cent. | According to value, Per cent. |
|---|---|---|
| From 1848 to 1868 ..... | 456·1 ..... | 315·4 |
| „ 1868 „ 1875 ..... | 164·7 ..... | 123·0 |
| „ 1848 „ 1875 ..... | 669·3 ..... | 388·3 |

The average production of the kingdom of Prussia amounts to eighty-five per cent of the total production of the German empire, being 898,769 metric tons (884,577 English tons) in 1876, and 878,433 metric tons (864,562 English tons) in 1877.

## RAILS.

In this important branch of manufacture Bessemer steel more and more takes the place of iron.

The quantities produced were as follows :—

| Year. | Iron Rails. | Steel Rails. | Total of Iron and Steel Rails. |
|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. |
| 1871..... | 320,619 | 128,406 | 449,025 |
| 1872..... | 320,996 | 179,092 | 500,088 |
| 1873..... | 385,601 | 186,643 | 572,244 |
| 1874..... | 364,978 | 237,894 | 602,872 |
| 1875..... | 227,976 | 241,505 | 469,481 |
| 1876..... | 126,288 | 253,746 | 380,034 |

There is as yet no official return of the production of 1877. It will most likely be about 400,000 tons, 350,000 tons of which at least being steel rails.

The *imported* and *exported* quantities of rails were :—

| Year. | Import. | Export. | Year. | Import. | Export. |
|---|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | | Metric Tons. | Metric Tons. |
| 1862 | 1,090 | 2,735 | 1872 | 11,706 | 70,699 |
| 1866 | 6,685 | 2,091 | 1873 | 44,578 | 70,683 |
| 1867 | 2,416 | 4,301 | 1874 | 8,590 | 84,864 |
| 1868 | 4,611 | 28,617 | 1875 | 6,937 | 122,224 |
| 1869 | 2,332 | 37,124 | 1876 | 684 | 133,484 |
| 1870 | 2,488 | 36,030 | 1877 | 76,034 | 225,630 |
| 1871 | 5,110 | 41,793 | | | |

Of the total quantity of 225,630 metric tons (222,067 English tons) returned for 1877, there were exported to Russia 65,357 metric tons (64,325 English tons); to Holland, 112,876 metric tons (111,094 English tons); to Austria, 9,268 metric tons (9,122 English tons); to Switzerland, 6,080 metric tons (5,984 English tons); to Belgium, 12,420 metric tons (12,224 English tons); the remainder was exported *via* the Baltic and North Sea ports. It is, however, only too likely that a portion of the rails exported to Russia is included in the export to Holland, for the same reasons that apply to the export of pig-iron, which are stated more fully above. Accordingly the figures of the total export would be too large by far. The same applies to the import. According to the official returns only 684 metric tons (673 English tons) of rails were imported in 1876. For 1877 the imported quantity is stated as 76,034 metric tons (74,833 English tons), implying a 111-fold increase of the import in the course of a single year. Now, without losing sight of the fact that the import duty on rails (amounting to twenty shillings per ton) was abolished on January 1, 1877, and that foreign competition immediately gained a footing on the free German market, it will be observed that the principal item of the import of rails—53,747 metric tons (52,898 English tons)—is said to be imported into the Baltic ports, a circumstance from which we may suppose that a considerable portion of it may be a transit of rails into Russia, however much the import of English rails into Germany may have been increased by the abolition of the duty.

## WIRE.

Certain descriptions of German iron are particularly suited to the *manufacture of wire*, and, owing to this, German wire is generally held in good repute. This applies to drawn as well as to rolled wire. But wire mills have been multiplied to such an extent that the production of wire in 1877—which was the only trade carried on with a slight profit in the previous year—seems far to exceed the demand.

The manufactured quantity of wire was :—

| Year. | Metric Tons. | Value in £ Sterling. | Year. | Metric Tons. | Value in £ Sterling. |
|---|---|---|---|---|---|
| 1848 | 5,396 | 125,620 | 1870 | 44,291 | 533,204 |
| 1853 | 16,263 | 296,942 | 1871 | 65,962 | 846,894 |
| 1857 | 19,526 | 398,137 | 1872 | 102,659 | 1,657,319 |
| 1866 | 27,502 | 349,782 | 1873 | 74,705 | 1,315,165 |
| 1867 | 31,641 | 399,928 | 1874 | 88,058 | 1,178,774 |
| 1868 | 45,385 | 506,040 | 1875 | 121,357 | 1,424,249 |
| 1869 | 45,360 | 515,111 | 1876 | 132,526 | 1,360,913 |

The percentage of the increase was :—

| | According to weight. Per cent. | | According to value. Per cent. |
|---|---|---|---|
| From 1848 to 1868 | 840·7 | ..... | 402·7 |
| „ 1868 „ 1875 | 267·5 | ..... | 281·5 |
| „ 1848 „ 1875 | 2247·2 | ..... | 1133·8 |

*Steel wire* is only manufactured in inconsiderable quantities, the entire amount being in 1875 only 153 metric tons (150 English tons), and in 1876, 72·3 metric tons (68·2 English tons).

## PLATES, SHEETS, AND TINPLATE.

The manufacture of *plates* and *sheets* is also exhibiting a considerable increase. According to the weight turned out, in 1875 it was 13·4 times as large as in 1848; but this is principally due to the manufacture of sheets, of which a quantity amounting to 113,786 metric tons (111,989 English tons) was manufactured in 1875. Of *steel sheets* only 2,901 metric tons (2,855 English tons) were turned out. The production of *tinplate* since 1848 is much smaller than that of sheets. From 1872 even a decrease is to be noticed, the foreign competition in this branch of manufacture being very brisk.

The aggregate production of *plates, sheets,* and *tinplate,* was :—

| Year. | Metric Tons. | Value in £ Sterling. | Year. | Metric Tons. | Value in £ Sterling. |
|---|---|---|---|---|---|
| 1848 | 8,929 | 193,799 | 1871 | 99,119 | 1,315,628 |
| 1853 | 27,170 | 535,567 | 1872 | 117,425 | 1,962,800 |
| 1857 | 36,495 | 774,863 | 1873 | 96,046 | 1,558,247 |
| 1867 | 69,507 | 861,329 | 1874 | 111,195 | 1,373,601 |
| 1868 | 91,485 | 1,097,433 | 1875 | 120,632 | 1,297,761 |
| 1869 | 98,686 | 1,176,246 | 1876 | 109,493 | 1,070,848 |
| 1870 | 86,767 | 1,059,078 | | | |

Of *tinplate* separately there were produced :—

| | Metric Tons. | | | Metric Tons. |
|---|---|---|---|---|
| For the year 1848..... | 782 | ..... | For the year 1873..... | 6,693 |
| „ 1853..... | 2,920 | ..... | „ 1875..... | 6,846 |
| „ 1857..... | 2,353 | ..... | „ 1876..... | 6,414 |
| „ 1872..... | 7,906 | ..... | | |

Besides the manufactures already enumerated, mention is to be made of the production of *railway axles* and *wheels,* of *sectional iron* (for building purposes), of *engine forgings, tubes, cannon* and *projectiles,* which are partly made of iron partly of steel. So far the returns of the *iron* manufactures only have been given, and in some few cases those of the *steel* manufactures also, for the purpose of facilitating a comparison. The following table will comprise all iron manufactures already enumerated, and will give a separate account of the *steel* manufactures.

The following quantities of *iron* and *steel* manufactures were produced. See Table I., page 100.

From this table we see at a glance that the quantity of all manufactures (smallware excepted) imported during 1877 is exhibiting a considerable increase compared with those of the previous year. Thus, for instance, the import of bar-iron has increased from 9,130 to 36,423 metric tons (from 8,986 to 35,848 English tons), that of angle-iron from 2,136 to 7,798 metric tons (from 2,102 to 7,675 English tons), and plates and sheets from 4,748 to 18,280 metric tons (from 4,673 to 17,991 English tons). There can be no doubt of this being the result of the abolition of the duties on iron on December 31st, 1876. We are, however, not able to define by exact figures how far this abolition may have gone in strengthening the foreign competition, as some transit items are likely to be comprised in the import figures as well as in those of export, which latter have also increased. The solitary exception of smallware, which has continued to be protected by an import duty and is showing a decrease of import instead of an increase, can hardly be considered an accidental circumstance, but rather as a proof of the unmistakeable effects of the abolition.

| I. Manufactures. | 1872. | 1873. | 1874. | 1875. | 1876. |
|---|---|---|---|---|---|
| | Met. Tons. | Met. Tons. | Met. Tons. | Met. Tons. | Met. Tons. |
| Iron rails and fish-plates | 344,124 | 385,601 | 364,978 | 227,976 | 126,288 |
| Steel rails and fish-plates | 155,964 | 186,643 | 237,894 | 241,504 | 253,746 |
| Total | 500,088 | 572,244 | 602,872 | 469,480 | 380,034 |
| Iron railway axles and wheels | 21,472 | 19,950 | 16,711 | 13,483 | 9,761 |
| Steel railway axles and wheels | 65,822 | 66,630 | 51,137 | 48,014 | 46,374 |
| Total | 87,294 | 86,580 | 67,848 | 61,497 | 56,135 |
| Sectional iron (for building purposes) | 91,493 | 90,121 | 94,361 | 98,151 | 106,973 |
| Iron plates, forgings, engine pieces | 31,641 | 37,399 | 42,814 | 31,293 | 37,100 |
| Steel plates, forgings, engine pieces | 7,910 | 8,162 | 6,183 | 7,617 | 12,248 |
| Total | 39,551 | 45,561 | 48,997 | 38,910 | 49,348 |
| Other descriptions of manufactured iron | 466,470 | 459,539 | 474,972 | 473,378 | 463,977 |
| Other descriptions of manufactured steel | 45,941 | 39,413 | 57,236 | 41,079 | 40,406 |
| Total | 512,411 | 498,952 | 532,208 | 514,457 | 504,383 |
| Iron sheets | 109,518 | 89,352 | 103,627 | 113,786 | 103,080 |
| Steel sheets | 3,323 | 2,615 | 2,717 | 2,901 | 4,889 |
| Tinplate | 7,906 | 6,693 | 7,568 | 6,846 | 6,414 |
| Iron wire | 102,659 | 74,705 | 88,058 | 121,357 | 132,526 |
| Steel wire | 25 | 25 | 96 | 153 | 8 |
| Tubes | 3,110 | 3,530 | 3,897 | 2,515 | 4,248 |
| Cannon and projectiles | 6,597 | 6,938 | 6,683 | 6,068 | 8,469 |
| Total | 1,403,975 | 1,477,816 | 1,558,932 | 1,436,121 | 1,356,508 |
| Total iron manufactures | 1,178,893 | 1,166,891 | 1,196,986 | 1,038,785 | 990,368 |
| Total steel manufactures | 285,582 | 310,425 | 361,946 | 347,336 | 336,140 |
| Total iron and steel | 1,403,975 | 1,477,316 | 1,558,932 | 1,436,121 | 1,356,508 |

The *imported* and *exported* quantities of the above-named manufactures (as far as they have not been returned before) are as follow :—

| Manufactures. | 1872. | | 1876. | | 1877. | |
|---|---|---|---|---|---|---|
| | Import. | Export. | Import. | Export. | Import. | Export. |
| | Met. Tons. | Met. Tons. | Met. Tons. | Met. Tons. | Met. Tons. | Met. Tons. |
| Forged and rolled bar-iron | 27,374 | 27,950 | 9,130 | 51,176 | 26,423 | 85,431 |
| Angle-iron | 8,086 | 767 | 2,136 | 563 | 7,798 | 4,174 |
| Plates and sheets | 13,250 | 3,580 | 4,748 | 11,543 | 18,280 | 21,208 |
| Tinplate | 2,362 | 234 | 3,740 | 441 | 4,082 | 1,645 |
| Iron and steel wire | 2,565 | 7,000 | 2,742 | 15,801 | 3,181 | 31,791 |
| Ploughshares, anchors & cables | 1,485 | 404 | 1,483 | 273 | 3,092 | 165 |
| Wrought-iron tubes | 4,456 | 4,028 | 2,410 | 1,616 | 4,618 | 5,970 |
| Iron and steel smallware | 580 | 1,860 | 679 | 1,328 | 603 | 1,527 |

## TOTAL PRODUCTION OF THE GERMAN IRONWORKS.

By summing up *all the goods made from pig-iron—i.e.*, the productions of the ironfoundries, of the rolling-mills for bar-iron, rails, sheets, wire, &c., and the steel manufactures—we obtain the figures contained in the following table :—

| Year. | Metric Tons. | Value in £ Sterling. | Years. | Metric Tons. | Value in £ Sterling. |
|---|---|---|---|---|---|
| 1848 | 205,133 | 2,948,319 | 1873 | 2,009,287 | 27,008,737 |
| 1868 | 1,076,476 | 12,285,568 | 1874 | 2,054,980 | 22,139,167 |
| 1870 | 1,277,270 | 14,146,905 | 1875 | 1,943,633 | 18,190,342 |
| 1872 | 1,984,151 | 26,811,748 | 1876 | 1,835,224 | 15,357,298 |

The percentage of the increase (the initial figures of each period taken = 100) is as follows :—

| | According to Weight. Per cent. | | According to Value. Per cent. |
|---|---|---|---|
| From 1848 to 1868..... | 524·7 | ..... | 416·7 |
| „ 1868 „ 1875..... | 180·5 | ..... | 148·0 |
| „ 1848 „ 1875..... | 947·4 | ..... | 617·0 |

Finally, we give the returns of the *entire production of the ironworks* for two years, in order to show its enormous increase, which has been effected in spite of the impediments and disadvantages from which the production as well as the market is suffering. The entire production was :—

| In 1848. | Metric Tons. | Value in £ Sterling. | Number of Workmen. |
|---|---|---|---|
| Of iron ores ..... | 693,725 | 187,417 | 15,610 |
| „ pig-iron ..... | 205,342 | 1,203,213 | 13,823 |
| „ manufactured iron and steel. | 164,752 | 2,364,652 | 25,727 |
| Total ..... | ... | 3,755,282 | 55,160 |
| **In 1875.** | | | |
| Of iron ores ..... | 4,730,553 | 1,208,245 | 28,136 |
| „ pig-iron ..... | 1,981,736 | 6,887,780 | 22,760 |
| „ manufactured iron and steel. | 1,943,633 | 18,190,343 | 114,003 |
| Total ..... | ... | 26,386,318 | 164,901 |

According to this the value of the production has, from 1848 to 1875, increased in the ratio of 100:702 ; the number of workmen in that of 100:298·1. The value produced by one workman was Rm. 1,392 (£68 4s. 2d.) in 1848, and Rm. 3,272 (£160 6s. 7d.) in 1875.

Our review of the German iron industry would be incomplete without a farther account of the use of steel, bar and sectional iron, sheets and plates, wire, castings and forgings, &c., for the purposes of *engine*, *wagon*, and *shipbuilding*, the manufacture of *boilers*, *locomotive* and *portable engines*, of *iron* and *steel ware* of every description and quality, of the application of iron to *building purposes*—in short, of the conversion of iron and steel into the innumerable *large* or *small objects* of *daily use*. But the statistical information available for this purpose is

## GENERAL SITUATION AND FUTURE PROSPECTS.

When speaking of the different iron and steel manufactures we omitted to give a special account of the fluctuations of the prices during late years, as we preferred to reserve a tabular statement of the same for the present occasion.

The following is a list of the prices paid in the German iron market during the years 1871 to 1877, per metric ton at the works :—*

| | July 1, 1871. | July 1, 1872. | July 1, 1873. | July 1, 1874. | July 1, 1875. | July 1, 1876. | Jan. 1, 1877. | Dec. 31, 1877. |
|---|---|---|---|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| White Luxemburg forge pig-iron. | 2 16 10 | 5 2 11 | 5 10 9 | 2 15 1 | 2 9 0 | 2 2 2 | 1 18 3 | 1 16 3 |
| Common Westfalian ,, | 3 4 8 | 5 12 8 | 5 17 7 | 2 15 10 | 2 12 11 | 2 7 0 | 2 5 1 | 2 1 2 |
| White ,, ,, | 3 18 5 | 8 10 6 | 7 16 10 | 3 19 5 | 3 10 7 | 2 18 10 | 2 16 10 | 2 10 11 |
| Spiegeleisen ..... | 5 5 10 | 10 5 10 | 11 9 4 | 4 17 2 | 4 10 2 | 3 16 5 | 3 10 7 | 3 4 8 |
| German foundry pig-iron, No. 1. | 4 2 2 | 7 7 0 | 7 12 11 | 4 2 4 | 3 16 5 | 3 8 7 | 3 6 8 | 2 18 10 |
| ,, Bessemer ,, ,, | 5 7 10 | 8 16 5 | 9 2 3 | 4 19 11 | 4 8 2 | 4 2 4 | 3 18 5 | 3 11 6 |
| Westfalian bar-iron ..... | 8 16 5 | 13 4 7 | 13 4 7 | 10 2 10 | 8 4 8 | 7 2 1 | 6 12 4 | 5 19 7 |
| Westfalian & Silesian iron rails. | 9 16 0 | 14 18 11 | 13 4 7 | 10 2 10 | 8 4 8 | 6 17 2 | 6 12 4 | 5 17 7 |
| Bessemer rails ..... | 14 14 0 | 19 2 2 | 17 18 8 | 12 9 11 | 10 5 10 | 7 12 11 | 7 12 11 | 6 5 5 |
| Boiler plates—1st quality ..... | 12 5 0 | 17 8 0 | 20 11 7 | 12 6 11 | 10 15 7 | 10 2 10 | 8 16 5 | 8 6 7 |
| Iron fish-plates ..... | 11 5 5 | 14 4 2 | 14 18 11 | 10 15 7 | 8 16 5 | 7 7 0 | 6 9 4 | 6 1 6 |
| Rolled wire ..... | 13 17 4 | 18 12 5 | 17 17 8 | 13 6 7 | 9 4 3 | 8 8 7 | 7 9 11 | 7 5 1 |
| Bridge castings ..... | 21 11 2 | 27 13 8 | 26 19 0 | 19 0 3 | 14 17 11 | 12 5 0 | 10 5 10 | 9 11 1 |
| Railway axles and wheels complete—per pair ..... | 22 10 10 | 25 9 7 | 28 8 [illegible] | 20 11 7 | 18 17 4 | 15 8 8 | 12 14 10 | 11 16 2 |

The present state of the iron trade is sufficiently evident from the exceedingly low prices in the last column of this table. The works are frequently selling *below the prime cost* with a view of being at least partially employed, and of keeping foreign competition from the home market as much as possible; and and as they are not able to dispose thus of their entire production at home they are trying to sell the remainder abroad at the *lowest possible prices.*

The results of such measures are evident from a publication of the financial status of the joint-stock companies in the German iron trade, according to their last balance-sheets compiled on behalf of the Association of German Iron and Steel Manufacturers, and issued in March, 1878. An aggregate balance has been struck from the individual balances of 1877, and the result is that 125 joint-stock companies, having an aggregate share capital of 497,662,754 Rm. (£24,335,709), instead of making a profit have lost 44,303,442 Rm. (£2,166,438), or 8·9 per cent. of their capital. Since the outbreak of the crisis 115 of these works have been obliged to discharge 37,547 workmen (32·2 per cent of the whole number); and 3,701,775 Rm. (£181,017) per month (41·1 per cent), or 44,421,300 Rm. (£2,172,202) per year less wages are now being paid. According to the quotations of the Berlin share market the share capital as quoted above (497,662,754 Rm.) at present represents a current value of about 150,000,000 Rm. (£7,335,000).

The whole capital invested in the German iron trade is stated to be about 3,600,000,000 Rm. (£176,049,000), and as the works owned by private persons will hardly be any better off, the entire loss may be estimated accordingly.

It is well known that the iron trade of all countries of the world is in an extremely depressed state just now, and it would be unreasonable to expect exceptional circumstances in the case of Germany. But here the situation has been considerably aggravated by the abolition of the import duties, which, considering the more favourable situation of English competition, was passed not only too early, but also at the most critical time—during a dangerous crisis, and simultaneous with a general over-production.

* The highest prices (not recorded in this table) were paid from November, 1872, until May, 1873.

The German iron trade is not likely to demand the temporary renewal of the import duties until German ironmasters possess the same wealth, the same stock of skilled workmen, and as good a market in some future German colonies as their English competitors. But it is entitled to expect a due consideration of the most important question at least—that of a cheap rate of transport. It is absolutely necessary for the German iron industry to be in this respect on a par with its English, Belgian, and French competitors; and this can only be accomplished by a reduction of the railway tariffs, by the construction of new canals, and the improvement of the existing waterways.

The question of import duties in Germany would be essentially altered, if other nations in an equally advanced state of civilisation could be induced to abolish their duties on iron, instead of sending their productions into Germany duty free, and levying duties upon German manufactures. This would tend to favour exportation from Germany, and at the same time protect the German market against foreign over-production, which, as a matter of course, is now gravitating towards it. But, according to all appearances, an abolition of the duties on iron, or even a reduction worth mentioning, is not to be expected from the neighbouring nations at the present moment, as the prevalent tendency is rather to protect their native iron industries even more effectively than hitherto, against the overpowering English competition.

Under these circumstances, the future of the German iron trade is more than ever dependent upon the commercial legislation of the empire, especially upon an improvement in the means of transport, and from the drift of commercial policy generally speaking. But it may be safely said that, if the legislative bodies choose to persist in the views hitherto entertained, the interests of the German iron trade will be most seriously imperilled, and even its continued existence will become questionable.

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# AUSTRO-HUNGARY.

## 624,044·88 SQUARE KILOMETRES. 37,700,000 INHABITANTS.

## COAL.

THE beginnings of coalmining in Austria date from the 16th century. The first lignite mine was opened in Bohemia in the year 1550, and the first coalmine in the same country thirty years later (1580). Other provinces of the empire (Styria, Lower Austria, and Moravia) only followed in the 17th and 18th centuries.

For centuries, however, the mineral coal only served to supply a very insignificant local demand, because the means for carrying the fuel to a greater distance, and particularly in larger quantities, were completely wanting; and because the forests, of which there was great abundance, supplied the necessary fuel for domestic use and for the industry which was then in a state of infancy.

When the extent of railways increased, when steam began to be generally adopted as a motive power, and coke was used as fuel for the blast-furnaces, and

lastly, when the price of wood began to rise, the demand for coal became more general in Austria and capital was eagerly and successfully employed in coal-mining.

The most powerful influence on the progress of coalmining in Austria was exerted, as in other countries, by the railways. The extension of the railway system is closely connected with the increase in the production of coal and with the rise of the iron industry.

A clear idea of the development of coalmining in the Austro-Hungarian empire may be obtained from the following table :—

| Year. | Production and Value of Mineral Coal. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Coal. | | | Lignite. | | | Total. | |
| | Metric Tons. | £ Sterling. | Per Cent. of Total Output | Metric Tons. | £ Sterling. | Per Cent. of Total Output | Metric Tons. | £ Sterling |
| 1819.. | .. | .. | .. | .. | .. | .. | 94,607 | .. |
| 1825.. | .. | .. | .. | .. | .. | .. | 154,944 | .. |
| 1830.. | .. | .. | .. | .. | .. | .. | 211,298 | 79,494 |
| 1835.. | .. | .. | .. | .. | .. | .. | 250,782 | .. |
| 1840.. | .. | .. | .. | .. | .. | .. | 469,212 | 149,456 |
| 1845.. | .. | .. | .. | .. | .. | .. | 721,707 | .. |
| 1850.. | 584,068 | 235,912 | 61·9 | 360,255 | 105,699 | 38·1 | 944,323 | 345,611 |
| 1855.. | 1,180,449 | 478,284 | 56·2 | 920,601 | 264,710 | 43·8 | 2,101,050 | 738,594 |
| 1860.. | 1,948,180 | 587,789 | 55·7 | 1,548,306 | 347,626 | 44·3 | 3,496,495 | 935,418 |
| 1865.. | 2,836,884 | 936,930 | 55·0 | 2,232,419 | 505,349 | 45·0 | 5,069,303 | 1,442,279 |
| 1870.. | 4,295,775 | 1,662,488 | 51·2 | 4,060,169 | 1,002,650 | 48·8 | 8,355,944 | 2,665,138 |
| 1871.. | 4,969,980 | 2,204,014 | 49·4 | 5,078,058 | 1,349,170 | 50·6 | 10,048,038 | 3,553,184 |
| 1872.. | 4,788,455 | 2,368,292 | 45·4 | 5,767,612 | 1,556,581 | 54·6 | 10,556,067 | 3,924,872 |
| 1873.. | 5,171,189 | 2,600,571 | 43·5 | 6,732,884 | 1,852,717 | 56·5 | 11,904,073 | 4,453,288 |
| 1874.. | 5,096,659 | 2,345,571 | 41·5 | 7,183,098 | 1,854,502 | 58·5 | 12,279,757 | 4,200,073 |
| 1875.. | 5,185,234 | 2,104,297 | 40·3 | 7,666,812 | 1,762,664 | 59·7 | 12,852,046 | 3,866,961 |
| 1876.. | 5,564,331 | 2,123,457 | 41·6 | 7,798,255 | 1,691,899 | 58·4 | 13,362,586 | 3,815,356 |

This compilation may be further explained and completed by the following remarks.

The official returns concerning the output of coal only commence with the year 1819, and the production of coal and lignite has not been stated separately before 1851.

Prior to the opening of the first railway—the Kaiser Ferdinands-Nordbahn—in the year 1837, the production of coal exhibits but an inconsiderable increase, and is also subject to many fluctuations. A regular supply of fuel was not then possible, and depended in a great measure upon the condition of the roads.

Since the year 1837, however, a regular and continued increase in the coal production is perceptible, especially as the first application of lignite for producing high temperatures, and a marked increase in the use of steam-power as well as of mineral fuel in the leading industries, date from the same time. But the opening of new railways had, as has been already stated, the greatest effect on the rapid progress of coalmining. This was not so much due to the increase of the demand for working the lines (which constitutes about 15·5 % of the total consumption of the country), but rather to an indirect agency of the railways, by which the transport of mineral fuel and the emancipation of manufacturing industry from watercourses were made possible, and the growth of the large inland towns was promoted.

The total output of coal in 1876 exceeded 142 times the produce of the year 1819, three times that of 1862, and was nearly twice as large as that of the year

1868, an increase which is due almost exclusively to the activity in the coal districts of Bohemia, Moravia, Silesia, and Styria. The decline of the output in 1866 is explained by the warlike events of that year.

The total value of coal and lignite produced in Austro-Hungary during the year 1876 amounted to £3,815,356.

In looking at the above table we find that the production of lignites in Austria increases far more rapidly than the production of coal, for according to this table the output of lignites during 1871 exceeded that of coal, and the advance gained by the lignites increased from year to year until 1875. The singular fact, which is of great importance to the country, is the rapid and unexampled rise in the production of the lignite district of the Erzgebirge. The lignites of this district, owing to their excellent qualities, meet with a continually increasing appreciation, and their sale is constantly extending.*

Austria does not possess coal districts which, as regards extent and importance, could vie with those of Westfalia or with the large English and American coalfields. With the exception of the Kladno-Schlan-Rakonitz district they are only of small extent, and can in many cases only be worked with difficulty; but they yield mostly a fuel which, owing to its caking quality, has attained a high economical importance for the whole empire with regard to the utilisation of the excellent ore deposits of the country.†

The Austrian *coal districts* are situated along a line running from west to east, commencing near Pilsen at the Bavarian frontier, extending into Galicia near to the Russian frontier, and comprising the districts of Pilsen, Kladno-Schlan-Rakonitz, Schatzlar-Schwadowitz, Ostrau-Karwin, and Jaworzno. There are also coal districts in the south and south-east of Hungary, containing the mines of Fünfkirchen and Steyerdorf. Separated from the other districts is that of Rossitz, in Moravia.

Austria is provided in an extraordinary degree with deposits of excellent *lignite*, which are actually inexhaustible, and can be easily worked. They are not only excellently adapted for domestic use but also to the most various branches of industry, as for engine coal, for the reduction of lead ores, and lastly, for the Bessemer process and for blast-furnaces.

The most important lignite district, as regards both superficial area and thickness of seams, is situated on the southern slope of the Erzgebirge, and with its produce of 4·8 million of metric tons (1876) it is now occupying the first rank among all coal districts of Austria. Other but far less extensive lignite districts are found between the outer ranges of the Alps, and especially on their eastern slope in Styria and Carniola (Traunthal, Köflach, Leoben, Fohnsdorf, Hrastnigg, Cilli, Sagor, &c.) Lastly, the lignite districts of Hungary and Transylvania must be mentioned, among which especially that of Salgó-Tarján in the Matra district, and that of the Szill Valley, are promising well for the future. The latter is of the greatest importance for the countries of the Lower Danube. The export of coal from the south Hungarian districts to Roumania will become more extensive as soon as the projected railway line from Petrozeny, in the Szill Valley along the Vulcan Pass to Pitesti, in Roumania, is carried out.

The extent to which the various coal districts have taken part in the total output of the Austro-Hungarian empire in 1862, 1867, and 1876, is apparent from the following table:—

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* Rossiwall, Die Entwicklung des Mineralkohlen-Bergbaues in Oesterreich. Statistische Monatsschrift, 3 Jahrgang, Wien, 1877.

† Kohlenrevierkarte der österreichisch-ungarischen Monarchie von J. Pechar, 2 Aufl., Wien, 1873.

| District. | 1862. | | 1867. | | 1876. | | |
|---|---|---|---|---|---|---|---|
| | Metric Tons. | Per Cent. | Metric Tons. | Per Cent. | Metric Tons. | Per Cent. | Price per 50 Klo. at the Pit's Mouth. |
| Coal. | | | | | | | d. |
| Kladno-Schlan-Rakonitz (Bohemia) | 839,950 | 18·5 | 983,363 | 16·1 | 1,516,268 | 11·3 | 3 |
| Ostrau-Karwin (Silesia) | 596,315 | 13·2 | 817,435 | 13·4 | 1,502,359 | 11·2 | 5 |
| Pilsen (Bohemia) | 334,856 | 7·4 | 566,412 | 9·3 | 1,077,834 | 8·0 | 5 |
| Jaworzno (Galicia) | 109,557 | 2·4 | 135,488 | 2·2 | 337,375 | 2·5 | 3 |
| Schatzlar-Schwadowitz (Bohemia) | 100,887 | 2·2 | 157,404 | 2·6 | 228,000 | 1·7 | 5 |
| Rossitz (Moravia) | 167,952 | 3·7 | 192,956 | 3·2 | 219,338 | 1·7 | 7 |
| Divers smaller districts | 49,488 | 1·1 | 68,289 | 1·1 | 53,160 | 0·4 | ... |
| Austria, total | 2,199,005 | 48·5 | 2,921,347 | 47·9 | 4,934,334 | 36·8 | 4 |
| Fünfkirchen (Ungarn) | ... | ... | 201,463 | ... | 341,571 | ... | ... |
| Steyerdorf (Ungarn) | ... | ... | 156,130 | ... | 242,559 | ... | ... |
| Divers smaller districts | ... | ... | 45,145 | ... | 45,867 | ... | ... |
| Austro-Hungary, Total | 2,523,305 | 55·6 | 3,324,085 | 54·5 | 5,564,331 | 41·6 | ... |
| Lignite. | | | | | | | |
| Erzgebirge district (Bohemia) | 768,085 | 16·9 | 1,239,869 | 20·3 | 4,785,571 | 35·7 | 2 |
| Köflach-Voitsberg (Styria) | 131,248 | 2·9 | 167,289 | 2·7 | 609,688 | 4·6 | 3 |
| Leoben-Fohnsdorf (Styria) | 215,542 | 4·8 | 231,682 | 3·8 | 425,391 | 3·2 | 6 |
| Traunthal (Upper Austria) | 129,256 | 2·8 | 180,031 | 3·0 | 283,840 | 2·1 | 5 |
| Sagor (Carniola) | 47,502 | 1·0 | 98,163 | 1·6 | 122,162 | 0·9 | 3 |
| Divers smaller districts | 466,367 | 10·1 | 523,283 | 8·6 | 706,729 | 5·3 | ... |
| Austria, total | 1,748,000 | 38·5 | 2,440,317 | 40·0 | 6,933,381 | 51·8 | 2 |
| Salgó-Tarján (Hungary) | ... | ... | 39,388 | ... | 298,061 | ... | ... |
| Szill Valley (Transylvania) | ... | ... | 14,650 | ... | 141,175 | ... | ... |
| Divers smaller districts | ... | ... | 280,364 | ... | 425,638 | ... | ... |
| Austro-Hungary, Total | 2,012,933 | 44·4 | 2,774,719 | 45·5 | 7,798,255 | 58·4 | ... |
| Coal and Lignite, Total | 4,536,238 | 100·0 | 6,098,804 | 100·0 | 13,362,586 | 100·0 | ... |

The most striking feature is again the enormous and, in its way, unique increase in the produce of the lignite district of the Erzgebirge, which has put the latter at the head of all coal districts of the Austro-Hungarian empire. A portion of 30·4 per cent, or nearly one-third of the total output of mineral coal in Austro-Hungary is now raised in the lignite district of north-western Bohemia, which for a long time has been but little appreciated. The second rank is taken by the coal districts of Kladno-Schlan-Rakonitz and Ostrau-Karwin, which, as regards their output, are nearly equal to each other.

The part taken by the various provinces in the total produce of coal and lignite, the number of mines and of workmen engaged in them, the efficiency of the latter, and lastly, the monetary value of the produce, all for the year 1876, have been arranged in the following table :—

## Coal.

| Country. | No. of Mining Concerns. | | Production. | | No. of Workpeople. | | | | Metric Tons of Coal raised by one miner per anm. |
|---|---|---|---|---|---|---|---|---|---|
| | Total. | Working. | Metric Tons. | Value in £ Sterling. | Men. | Women | Children. | Total. | |
| Bohemia ..... | 277 | 143 | 2,828,138 | 958,382 | 18,493 | 1,579 | 654 | 20,726 | 1,862 |
| Silesia ..... | 15 | 15 | 1,246,431 | 482,294 | 8,712 | 627 | 46 | 9,385 | 1,328 |
| Moravia ..... | 18 | 15 | 485,126 | 238,313 | 3,347 | 269 | 15 | 3,631 | 1,336 |
| Galicia ..... | 17 | 5 | 337,375 | 97,268 | 1,034 | 170 | 20 | 1,824 | 1,850 |
| Lower Austria .. | 25 | 16 | 35,703 | 23,531 | 469 | 8 | .. | 447 | 748 |
| Styria ..... | 19 | 12 | 6,387 | 4,506 | 267 | 25 | .. | 292 | 219 |
| Upper Austria .. | 4 | 3 | 174 | 181 | 43 | 2 | .. | 45 | 89 |
| Tyrol ..... | 1 | 1 | .. | .. | 2 | .. | .. | 2 | .. |
| Carniola ..... | 1 | .. | .. | .. | 1 | .. | .. | 1 | .. |
| Total..... | 377 | 210 | 4,934,334 | 1,804,276 | 32,968 | 2,680 | 735 | 36,383 | 1,356 |
| Hungary and adjacent Countries | .. | .. | 629,997 | 319,181 | .. | .. | .. | .. | .. |
| Austro-Hungary .. | .. | .. | 5,564,331 | 2,123,457 | .. | .. | .. | .. | .. |

## Lignite.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Bohemia ..... | 668 | 291 | 4,841,309 | 747,677 | 12,895 | 613 | 79 | 13,587 | 3,563 |
| Styria ..... | 107 | 60 | 1,454,076 | 492,906 | 6,922 | 909 | 94 | 7,925 | 1,835 |
| Upper Austria.... | 5 | 4 | 283,841 | 71,334 | 1,127 | 53 | 40 | 1,220 | 2,327 |
| Carniola ..... | 18 | 13 | 122,162 | 33,787 | 663 | 24 | 8 | 695 | 1,755 |
| Moravia ..... | 14 | 10 | 100,272 | 20,508 | 698 | 9 | .. | 707 | 1,418 |
| Carinthia ..... | 19 | 10 | 52,186 | 25,728 | 695 | 168 | 17 | 880 | 593 |
| Lower Austria.... | 13 | 7 | 26,666 | 10,283 | 215 | 2 | 9 | 226 | 1,180 |
| Istria ..... | 1 | 1 | 25,950 | 20,895 | 566 | .. | .. | 566 | 459 |
| Tyrol ..... | 3 | 3 | 18,140 | 13,624 | 206 | .. | .. | 206 | 881 |
| Dalmatia ..... | 6 | 3 | 5,255 | 2,448 | 130 | 2 | 5 | 137 | 384 |
| Galicia ..... | 9 | 4 | 2,454 | 691 | 93 | .. | .. | 93 | 265 |
| Silesia ..... | 1 | 1 | 1,043 | 349 | 7 | .. | .. | 7 | 1,490 |
| Görz and Gradisca | 2 | 1 | 15 | 22 | 6 | .. | .. | 6 | .. |
| Vorarlberg ..... | 1 | 1 | 9 | 4 | 12 | .. | .. | 12 | .. |
| Bukowina..... | 1 | .. | .. | .. | 3 | .. | .. | 3 | .. |
| Total ..... | 868 | 409 | 6,933,381 | 1,440,262 | 24,238 | 1,780 | 252 | 26,270 | 2,639 |
| Hungary and adjacent Countries | .. | .. | 864,874 | 251,638 | .. | .. | .. | .. | .. |
| Austro-Hungary.. | .. | .. | 7,798,255 | 1,691,899 | .. | .. | .. | .. | .. |
| Total Production of Coal ..... | .. | .. | 13,362,586 | 3,815,356 | .. | .. | .. | .. | .. |

Up to the end of 1876 the superficial area of all concessions granted in Austria (without Hungary) for working mineral coal amounted to 126,626·4 hectares. The number of steam engines used for coalmining purposes during the year 1876 was :—

| | Winding Engines. | Pumping Engines. | Winding and Pumping Engines Combined. | Total Number of Engines. |
|---|---|---|---|---|
| At Coal Mines ..... | 187 | 175 | 37 | 399 |
| At Lignite Mines ..... | 229 | 198 | 48 | 475 |
| Total ..... | 416 | 373 | 85 | 874 |

With regard to the foreign coal trade of Austro-Hungary we give in the following table a return of the quantities *imported* and *exported*, and also the production, which affords more detailed information respecting the inland consumption :—

| Year. | Production. | Import. | | Export. | | Consumption. |
|---|---|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | £ Sterling. | Metric Tons. | £ Sterling. | Metric Tons. |
| 1835 ..... | 250,782 | 16,128 | ... | 2,737 | ... | 264,173 |
| 1840 ..... | 469,212 | 26,123 | ... | 26,443 | ... | 468,892 |
| 1845 ..... | 721,707 | 37,343 | ... | 49,207 | ... | 709,843 |
| 1850 ..... | 944,323 | 79,039 | ... | 70,275 | ... | 1,053,087 |
| 1855 ..... | 2,101,050 | 62,949 | ... | 129,397 | ... | 2,034,602 |
| 1860 ..... | 3,496,495 | 240,128 | ... | 279,675 | ... | 3,456,948 |
| 1865 ..... | 5,069,303 | 366,488 | ... | 385,662 | ... | 5,050,129 |
| 1870 ..... | 8,355,944 | 927,119 | ... | 925,198 | ... | 8,357,865 |
| 1871 ..... | 10,048,038 | 1,363,974 | ... | 1,046,501 | ... | 10,365,511 |
| 1872 ..... | 10,556,067 | 1,587,800 | ... | 1,167,401 | ... | 10,876,466 |
| 1873 ..... | 11,904,073 | 1,785,266 | ... | 1,681,029 | ... | 12,008,310 |
| 1874 ..... | 12,279,757 | 1,627,355 | 954,932 | 2,160,812 | 845,310 | 11,746,300 |
| 1875 ..... | 12,852,046 | 1,627,942 | 796,064 | 2,703,237 | 1,004,631 | 11,776,751 |
| 1876 ..... | 13,362,586 | 1,574,575 | 769,967 | 2,734,862 | 989,637 | 12,202,299 |

From this table it is apparent that for a long time—about up to the year 1866—the import and export of coal in the Austro-Hungarian State have only been carried on in the shape of an inconsiderable frontier traffic; but from that time they have made an extraordinary advance owing to the completion of numerous railways by which the interior of the empire has been made accessible to or from the coal districts. The foreign coal trade of Austria consists in the export of lignite from the Erzgebirge (north-western Bohemia), and also of Pilsen coal to Germany, and in the import of considerable quantities of coal and coke from the Prussian province of Silesia, which take their way in the direction of Vienna, and meet with a remunerative sale. The extraordinary increase of the quantity of coal exported in the time from 1870 to 1876, during which the export—amounting in 1876 to 2·7 million metric tons—has been trebled, is very conspicuous too. This circumstance again is explained by the nearly unparalleled development of the lignite district of the Erzgebirge.

The above table further illustrates the fact that the import of mineral fuel, consisting almost exclusively of Prussian coal, had reached its maximum in 1873. Since that time it has decreased, although not very considerably, as in the year 1876 it still amounted to nearly 1·6 million metric tons. This large import of Silesian coal is rather startling, considering that the road, upon which it is carried into Austria, touches first on Austrian soil the extensive coal district of Ostrau. This district is a very productive one, and yields a coal which is only little inferior to the Prussian coal in heating power. It cannot be explained by special advantages being afforded to the Prussian coal on the part of railway companies interested in the latter; it is rather to be credited to the better quality of it, to the more favourable conditions under which it is mined, and which reduce the cost of production, and lastly, to the greater percentage of cops which it contains.

In the last tabular return of the imported and the exported quantities of coal, the *home consumption* has already been stated as amounting to 12,202,299 metric tons in 1876. Taking the population of the Austro-Hungarian monarchy at 37·7 million inhabitants, this quantity corresponds to a consumption of 0·324 tons per head, while the production is 0·355 tons per head.

The statistical returns available are not sufficient to enable us to give more

detailed information relating to the consumption of mineral coal according to the different purposes to which it is applied. Only the quantities used by railways, the inland navigation, and some large branches of industry, are to some extent known. ROSSIWAL states that the total consumption of mineral coal in Austro-Hungary during the year 1875 has to be distributed as follows :—

15·5 % have been used by the railways.
2·0 % „ „ inland navigation.
55·0 % „ „ manufacturing industries.
27·5 % „ in dwelling-houses and by domestic industry.

From the publications issued by the Austrian Board of Trade we select the following information respecting the boilers and steam engines of the Austrian empire. Comparative returns of this description are given from time to time, and are of great use to the public; in this special case they not only afford information concerning the state of trade generally speaking, but also a pretty correct notion of the distribution of mineral fuel may be obtained from them.

The following number of steam engines were at work in Austro-Hungary in the years 1852 and 1863 :—

| | 1852. | | 1863. | |
|---|---|---|---|---|
| | Number of Engines. | Number of Horse-power. | Number of Engines. | Number of Horse-power. |
| For Agriculture | 9 | 59 | 358 | 3,284 |
| For Mining | 111 | 1,833 | 461 | 10,581 |
| For Manufactures | 630 | 8,473 | 2,841 | 44,410 |
| Total | 788 | 10,646 | 3,791 | 59,382 |
| Locomotive Engines | 440 | 29,248 | 1,329 | 264,465 |
| Marine Engines | 106 | 13,059 | 294 | 40,000 |
| Grand Total | 1,334 | 52,953 | 5,414 | 363,847 |

The considerable advance of industrial activity within these eleven years is illustrated by the fact that the number of engines has been quadrupled, and the number of horse-power has even increased at the rate of one to seven. Since that time however the increase of all branches of industry has been enormous, as will be seen from the tabular return of the steam engines for 1875, on pages 112 and 113.

Most conspicuous in the above table is the very extraordinary development of all branches of industry in *Bohemia*, for the total heating surface of the steam boilers in this country is nearly half of the heating surface of all steam boilers of the empire.

As a rule the sugar manufactories and flour and cotton mills are the most important branches of industry, consequently they must be considered as the principal coal consumers.

Of the 11,378 steam boilers mentioned in the above table—

5,913 (51·9%) have been heated with coal.
2,377 (20·8%) „ „ lignite.
1,760 (15·4%) „ „ wood.
745 ( 6·6%) „ „ mixed fuel.
197 ( 1·8%) „ „ gaseous fuel.
92 ( 0·9%) „ „ coke.
77 ( 0·7%) „ „ peat.

STATISTICAL RETURN OF THE STEAM ENGINES EXISTI

| Description of Industry. | Entire Austria (without Hungary.) 375,627 square metres heating surface. | | | Bohemia. 161,654 square metres heating surface. | | | Moravia. 64,189 square metre heating surface. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Works. | Boilers. | Atmo-spheres. | Works. | Boilers. | Atmo-spheres. | Works. | Boilers. | Atm sphe |
| Sugar Manufactories, Flour Mills, &c. | 645 | 1,921 | 8,080 | 347 | 1,058 | 4,527 | 136 | 488 | 1,9 |
| Textile Industries | 1,024 | 1,692 | 6,979 | 448 | 818 | 3,470 | 169 | 263 | 1,1 |
| Coalmining | 365 | 1,381 | 6,109 | 237 | 777 | 3,732 | 20 | 147 | 7 |
| Iron and Steel Manufacture | 137 | 910 | 4,528 | 35 | 194 | 864 | 17 | 181 | 8 |
| Breweries, Distilleries, &c. | 1,682 | 1,875 | 4,487 | 406 | 475 | 1,413 | 198 | 212 | 5 |
| Engine and Machine Works | 222 | 476 | 2,336 | 72 | 121 | 555 | 24 | 39 | 1 |
| Saw Mills, &c. | 389 | 482 | 2,208 | 140 | 163 | 705 | 50 | 62 | 2 |
| Traffic (Pumping Stations of Railways) | 331 | 403 | 1,883 | 98 | 110 | 483 | 29 | 38 | 1 |
| Chemical Works | 286 | 466 | 1,777 | 90 | 146 | 533 | 36 | 47 | 1 |
| Agriculture | 380 | 400 | 1,657 | 215 | 227 | 970 | 71 | 76 | 3 |
| Paper Mills, &c. | 103 | 237 | 1,085 | 38 | 84 | 378 | 5 | 11 | |
| Hardware | 168 | 223 | 1,040 | 48 | 53 | 211 | 24 | 44 | 1 |
| Brick, Cement, and Glass Works | 138 | 197 | 919 | 75 | 102 | 446 | 13 | 17 | |
| Mining (excluding coal) | 63 | 166 | 800 | 30 | 87 | 429 | 8 | 22 | 1 |
| Divers | 135 | 185 | 823 | 52 | 58 | 133 | 13 | 20 | |
| Boilers without Engines | 295 | 364 | 1,089 | 82 | 101 | 329 | 35 | 42 | 1 |
| Total | 6,363 | 11,378 | 45,801 | 2,413 | 4,574 | 18,778 | 848 | 1,709 | 7,( |
| Boilers of Locomotive Engines (of 342,424 square metres heating surface at the end of 1875) | ... | 2,758 | 23,906 | ... | ... | ... | ... | ... | |
| Boilers of sea-going and river Steamers (of 63,475 square metres heating surface at the end of 1875) | 336 | 607 | 1,682 | ... | ... | ... | ... | ... | |
| Total | 6,758 | 14,743 | 71,389 | ... | ... | ... | ... | ... | |

The fuel used for the remainder of the boilers is unknown.

The merchant fleet of Austro-Hungary consisted at the end of 1876 of 98 steamers of 56,969 tons, and of 7,440 sailing vessels of 273,339 tons. The Imperial Navy was composed of 61 steamers of 114,830 tons, and 7 sailing vessels of 3,150 tons.

Coming to the *circulation* of the Austro-Hungarian coal, we have to deal first with the *lignite* district of the *Erzgebirge*, its rapid development having already been made conspicuous in the foregoing tables.

The quite extraordinary progress of the production of this district, which contains about 7,700 million of metric tons of workable coal, and in which much English and Belgian capital has been invested, is further characterised by the following chronological review:—

AUSTRIA (WITHOUT HUNGARY) IN 1875.*

| wer Austria. | | | Galicia. | | | Styria. | | | Silesia. | | | The remaining Provinces. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 square metres ting surface. | | | 31,798 square metres heating surface. | | | 23,093 square metres heating surface. | | | 29,835 square metres heating surface. | | | 23,058 square metres heating surface. | | |
| . Boilrs. | Atmo-spheres. | | W'rks. | Boilrs. | Atmo-spheres. | W'rks. | Boilrs. | Atmo-spheres. | W'rks. | Boilrs. | Atmo-spheres. | W'rks. | Boilrs. | Atmo-spheres. |
| 4 113 | 510 | | 43 | 118 | 527 | 12 | 26 | 114 | 29 | 78 | 338 | 24 | 40 | 101 |
| 9 208 | 913 | | 18 | 32 | 132 | 8 | 15 | 65 | 91 | 137 | 600 | 181 | 219 | 605 |
| 7 26 | 114 | | 29 | 81 | 328 | 37 | 108 | 524 | 26 | 215 | 963 | 9 | 27 | 115 |
| 5 85 | 442 | | 3 | 6 | 27 | 39 | 282 | 1,570 | 9 | 74 | 366 | 19 | 88 | 451 |
| 4 102 | 417 | | 704 | 729 | 1,118 | 28 | 40 | 177 | 146 | 156 | 372 | 146 | 161 | 428 |
| 3 172 | 979 | | 16 | 22 | 99 | 7 | 29 | 151 | 8 | 10 | 47 | 29 | 83 | 323 |
| 7 86 | 427 | | 55 | 73 | 338 | 22 | 25 | 117 | 19 | 23 | 104 | 46 | 50 | 230 |
| 4 63 | 328 | | 51 | 70 | 315 | 30 | 33 | 163 | 14 | 15 | 73 | 65 | 74 | 340 |
| 4 133 | 613 | | 39 | 52 | 143 | 14 | 27 | 107 | 13 | 25 | 82 | 30 | 36 | 119 |
| 9 9 | 40 | | 34 | 36 | 119 | 10 | 10 | 49 | 18 | 18 | 70 | 23 | 24 | 85 |
| 5 38 | 186 | | 3 | 10 | 56 | 11 | 28 | 138 | 4 | 10 | 44 | 27 | 56 | 239 |
| 3 66 | 331 | | 2 | 3 | 14 | 18 | 24 | 122 | 7 | 9 | 33 | 16 | 24 | 113 |
| 9 33 | 172 | | 9 | 12 | 58 | 7 | 14 | 69 | 6 | 6 | 25 | 9 | 13 | 60 |
| 2 2 | 10 | | 13 | 42 | 204 | 2 | 3 | 14 | 6 | 7 | 31 | 2 | 3 | 11 |
| 4 57 | 270 | | 4 | 5 | 17 | 13 | 18 | 92 | 1 | 1 | 5 | 18 | 26 | 241 |
| 5 89 | 325 | | 44 | 48 | 78 | 14 | 22 | 91 | 14 | 16 | 49 | 41 | 46 | 115 |
| 7 1,282 | 6,045 | | 1,067 | 1,339 | 3,573 | 272 | 704 | 3,563 | 411 | 800 | 3,202 | 685 | 970 | 3,576 |
| ... | ... | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| ... | ... | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| ... | ... | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |

| Year. | Concessions. | | Number of Proprietors | Length of Tramways. | | Steam Engines. | | Number of Miners. | Production in Metric Tons. | Average price at the pit's mouth of One metric cwt. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Area, Hectares | | Wood. | Wood and Iron Rails. | Winding. | Pumping. | | | |
| | | | | Metres. | | | | | | d. |
| 1860 | 1,751 | 18,587 | .. | 18,382 | 16,110 | 62 | .. | 7,318 | 341,638 | 4·2 |
| 1865 | 1,081 | 30,900 | 640 | 64,284 | 17,901 | 98 | .. | 6,293 | 844,387 | 4·2 |
| 1870 | 3,973 | 39,072 | 633 | 114,556 | 24,409 | 146 | .. | 6,691 | 1,795,526 | 4·2 |
| 1872 | 12,706 | 44,806 | 352 | 267,992 | 2,991 | 124 | 108 | 9,532 | 2,431,178 | 4·5 |
| 1874 | 10,328 | 53,892 | 650 | 540,475 | 3,969 | 163 | 142 | 13,507 | 4,163,010 | 4·2 |
| 1876 | 6,495 | 56,050 | 751 | 674,367 | 14,212 | 186 | 143 | 13,045 | 4,785,571 | 3·5 |

In 1876 the quantity of coal carried out of this district was distributed as follows:—

* Nachrichten über Industrie, Handel und Verkehr aus dem Statistischen Departement im k. k. Handels-Ministerium. XI. Band, Wien, 1877.

| | Metric Tons. |
|---|---|
| To foreign countries by rail | 1,988,875 |
| „ „ water (Elbe) | 481,127 |
| To different parts of Austria | 1,611,673 |
| Total | 4,081,675 |

The principal places of consumption of Bohemian lignite (of which the centres of production are situated at *Karbitz-Mariaschein* and *Dux-Ossegg*) are therefore in foreign countries, and especially in Northern Germany, where it has successfully penetrated even to the shores of the North Sea and the Baltic. Lately it has also become known in the south and south-west of Germany, and has even been used in Switzerland and in Alsace.* The Bohemian lignites may be termed, without contradiction, absolutely the cheapest mineral fuel of Europe.

The quantities of Bohemian lignite used at the principal places of consumption in the years from 1868 to 1876 have been as follows :—

| Year. | Metric Tons. | | | | | | |
|---|---|---|---|---|---|---|---|
| | Dresden | Berlin | Magdeburg | Prague | Leipzic | Hamburg | Vienna |
| 1868 ..... | 92,015 | 49,764 | 106,378 | 23,300 | 20,450 | ... | ... |
| 1869 ..... | 97,445 | 40,400 | 131,242 | 25,960 | 22,910 | 1,947 | ... |
| 1870 ..... | 109,482 | 50,563 | 139,872 | 34,090 | 30,240 | 2,010 | ... |
| 1871 ..... | 127,245 | 58,740 | 130,682 | 41,670 | 42,030 | 2,465 | 30 |
| 1872 ..... | 113,525 | 99,946 | 188,561 | 44,534 | 45,297 | 2,178 | 1,501 |
| 1873 ..... | 140,033 | 111,503 | 117,721 | 51,923 | 59,280 | 22,310 | 15,650 |
| 1874 ..... | 181,607 | 122,637 | 156,006 | 55,451 | 73,690 | 18,907 | 16,894 |
| 1875 ..... | 214,114 | 169,376 | 185,366 | 62,980 | 87,319 | 22,049 | 17,671 |
| 1876 ..... | 213,483 | 178,976 | 163,614 | 94,299 | 79,092 | 9,442 | 8,799 |

The coal of the *Kladno-Schlan-Rakonitz* district finds its principal market in the industrial parts of central Bohemia, containing a great number of sugar manufactories, and prevails particularly in the city of Prague. The Pilsen coal provides the south-west of Bohemia with fuel, and is exported in considerable quantities to Bavaria, which country is rather destitute of coal. The Plattel coal of Nürschan in the district of Pilsen is known far and wide as an excellent gas coal.

The *Ostrau-Karwin* coal district is important for the Austrian iron industry on account of its good coke. Notwithstanding this, only about eight per cent of the output of this district has been turned into coke during the year 1876. The Ostrau coal district also produces a very good gas coal. The circulation of the Ostrau coal is directed towards Vienna, and towards the east, namely, to Galicia and Hungary.

A more detailed description of the various coal districts of Austro-Hungary, as well as an accurate report on the coal trade of the empire, is contained in the official report on the Vienna Exhibition.

In connection with this we may give some figures on the quantity of fuel used in the Austrian capital.

The consumption within the rampart lines, consequently within the district subject to the consumption-tax of the city of Vienna (but exclusive of the outlying districts) has been :—

* J. Pechar, Karte über die Circulation der böhmischen Braunkohle während des Jahres 1870. Prag, 1871

| Year. | Coal and Lignite. | Charcoal. | Firewood. |
|---|---|---|---|
| | Metric Tons. | Metric Tons. | Cubic Metres. |
| 1847 | 26,744 | 6,936 | 909,526 |
| 1850 | 49,552 | 6,165 | 832,661 |
| 1860 | 100,399 | 4,839 | 735,073 |
| 1870 | 221,287 | 7,594 | 744,417 |
| 1873 | 270,170 | 3,258 | 671,166 |
| 1875 | 349,668 | 1,831 | 492,281 |
| 1877 | 357,155 | 1,795 | 469,200 |

This confirms the very considerable increase in the consumption of mineral fuel in Vienna, but we should not lose sight of the fact that the population of Vienna has increased about 30 per cent during that time, that industry and trade have also made considerable progress, and lastly, that the consumption of firewood during the last 30 years has not even decreased 50 per cent. But as the consumption of charcoal has been reduced almost to one-fourth, it must be concluded that mineral coal has been introduced into the various branches of industry far more easily than for domestic use. There are still enormous quantities of wood consumed for domestic purposes. The numerous outlying districts of Vienna, in which the industry is almost exclusively concentrated, are not considered in the above figures, so that the actual consumption of coal in Vienna is much more considerable, and can be taken as at least double that of the amount stated in the table, or equal to about 750,000 metric tons.

The mineral coal imported into Vienna is approximately composed of—

| | |
|---|---|
| Coal from Upper Silesia | 69% |
| „ Ostrau-Karwin | 18% |
| Various other descriptions (Styria, Rossitz, Pilsen) | 13% |

The *prices of coal* in Austro-Hungary have been considerably reduced during the last few years in consequence of the depression of trade, and the subsequent decrease in the demand. In the foregoing table of the production of the various coal districts we have stated the average prices at the pit's mouth in the year 1876, which differ only little from those which are now being paid at the place of production.

The necessary data for estimating the different descriptions of Austrian coal with regard to their chemical and heating power are contained in the excellent statistical tables on the fossil coals of Austria by C. v. HAUER.

The following quantities of coal have been used for coke-making in the year 1876:—

| | | |
|---|---|---|
| In the Ostrau District | 126,419 | Metric Tons. |
| „ Kladno „ | 71,973 | „ |
| „ Pilsen „ | 43,281 | „ |
| „ Schatzlar-Schwadowitz Dist. | 7,340 | „ |
| „ Rossitz District | 7,129 | „ |
| In Hungary | 2,974 | „ |
| Total | 259,116 | „ |

7,178 tons of coke from the basin of Ostrau have been sold to the Prussian province of Silesia. The average return of coke is from 55 to 61 per cent; only the coal of the Oravicza district, in Hungary, yields a higher percentage.

As a rule the production of coke from lignite has not yet given favourable results, nor has the manufacture of artificial fuel (*briquets*) yet left the experimental stage. The Danube Steam Navigation Company, however, manufactures large quantities of artificial fuel for its own use from Fünfkirchen coal, as, for instance, 17,471 metric tons in 1876, of a value of £12,561. Another manufactory of artificial fuel is at Ostrau.

The present means of communication existing in Austro-Hungary are :—

| | | |
|---|---|---|
| Railway lines ..... | 18,058 | kilometres. |
| Navigable rivers..... | 6,882 | „ |
| „ canals ..... | 265 | „ |
| „ lakes ..... | 858 | „ |

## IRON.

Austro-Hungary is so exceedingly well provided with good *iron ores* that one of the most indispensable conditions of an extensive and active iron industry may be said to be fulfilled there. Accordingly, the latter belongs to the most important industries of the empire. For the same reason Austria is not, like other countries, obliged to import considerable quantities of ores from foreign parts. Iron ores are mined in nearly all parts of the empire.

The Austro-Hungarian iron industry may be divided into three groups—each of them being capable of an independent existence by reason of its possessing the raw materials for producing pig-iron. The first and most important one is the group of the Alpine countries, comprising Styria, Carinthia, Carniola, Tyrol, and Upper and Lower Austria; the second is that of the Sudete countries of Bohemia, Moravia, and Silesia; and the third that of the Carparthian countries, comprising Hungary, Transylvania, Galicia, and the military frontier.

Styria and Carinthia are the most noteworthy of the Alpine countries on account of the almost inexhaustible quantity as well as the good quality of their ores, the greatest part of them belonging to the spathic description. In these provinces the two far-famed ore mountains, the Erzberg and the Hüttenberg, are situated. As regards both quantity and quality of their ores, these two mountains are almost unique in their way. It has been proved beyond doubt that each of them has already been worked for more than 1,000 years, and likewise that they and the ore-seams in their neighbourhood will last for 1,000 years more, even if the output should be considerably increased.*

It is even stated by J. G. KOHL, as a fact that the Roman weapons and ploughs, by which the world was conquered and civilised, were made from the ores of these mountains, which accordingly were occupied at an early date and retained for a long time by the Romans. The aggregate output of both ore mountains is more than 300,000 metric tons, with which the manufacture of the far-famed Styrian iron and steel is supplied.

The ore-beds of the Erzberg are for the greatest part cropping out at the surface. Their contents, exclusive of the great quantity of ores in the surrounding localities, are computed at from 125 to 150 millions of metric tons. The ore mountain of Hüttenberg is scarcely inferior to the former in this respect.

The ores are generally very pure, there being only a slight admixture of iron-and—though less frequently—of copper pyrites. The uncalcined ores contain on the average 40 to 42 per cent of iron; generally, however, they are calcined

* SCHAUENSTEIN, Denkbuch des österr. Berg-und Hüttenwesens. Vienna, 1873.

before smelting, and in this state they yield from 48 to 52 per cent of pig-iron on the average.

Amongst the other ore-mines of the Alpine group those of the Mariazell and and Neuberg ironworks are of especial importance. It has been proved by documents that ores were mined and worked at Mariazell as early as the year 1025. These ores are, however, neither as pure nor as rich as those of the the Erzberg and the Hüttenberg.

The Sudete group, in which Bohemia occupies the first place, yields ores of less percentage and quality but in larger quantities, and fairly suitable for manufacturing all common descriptions of wrought-iron, chiefly however for foundry pig-iron. The greatest part of the ores worked here are common and clayish red ores—in smaller quantities, also, brown ores and clay ironstone.

The beginnings of ironstone-mining in Bohemia extend back into prehistoric times, as ironworks are said to have existed near Cáslau as early as the year 677. The most important of the Bohemian ore deposits is that of Nucic, where 100,000 metric tons per annum are raised, three-quarters of which are apportioned to the Prague Ironworks Company. The considerable Krusnahora deposits also deserve to be mentioned here.

Moravia and Silesia are not in possession of such extensive and rich ore deposits, but the coal of the Ostrau district is supplying great quantities of excellent furnace coke.

Of the countries constituting the third Austrian iron district, that of the Carpathian mountains, Hungary is the first in exhibiting considerable deposits of ores of high quality and percentage. Among the northern deposits, extending along the southern slope of the Carpathian mountains, that of the Zeleznik river is the most important; that of Moravitza-Dognasca in the Banat, and the rich deposits extending into Transylvania from Telek across the Gyalar, following next. In Croatia also considerable deposits have lately been discovered.

The total output of iron ores in Austro-Hungary from 1851 to 1876 will be seen from the following table, containing at the same time the returns of import and export:—

| Year. | Production. | | Import. | | Export. | |
|---|---|---|---|---|---|---|
| | Metric Tons. | £ | Metric Tons. | £ | Metric Tons. | £ |
| 1851 | 573,079 | 269,027 | ... | ... | ... | ... |
| 1860 | 793,354 | 387,950 | ... | ... | ... | ... |
| 1866 | 630,429 | 180,002 | 3,879 | ... | 22 | .. |
| 1867 | 743,923 | 292,036 | 5,890 | ... | 63 | ... |
| 1868 | 874,499 | 240,889 | 5,832 | ... | 816 | ... |
| 1869 | 992,792 | 294,452 | 6,340 | ... | 680 | ... |
| 1870 | 1,156,708 | 359,568 | 8,366 | ... | 236 | ... |
| 1871 | 1,224,875 | 445,640 | 9,027 | .. | 102 | ... |
| 1872 | 1,360,612 | 520,269 | 15,675 | ... | 1,121 | ... |
| 1873 | 1,588,256 | 640,585 | 7,782 | ... | 24,255 | ... |
| 1874 | 1,329,797 | 520,011 | 4,167 | 2,038 | 30,509 | 32,822 |
| 1875 | 1,103,227 | 396,747 | 4,997 | 2,439 | 52,817 | 56,821 |
| 1876 | 902,421 | 316,261 | 2,429 | 1,188 | 38,159 | 41,052 |

According to these returns the quantity of ores raised attained its maximum in 1873, from which time to 1876 it decreased by 43·4%.

The rate at which the different countries contributed to the output of 1876 is shown by the following table:—

| Country. | Number of Mines. | | Production. | | Average price per 100 kilo. at the Mine. | Number of Workpeople. | | | | Metric Tons raised per head of workpeople. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total. | Working. | Metric Tons. | Value in £. | s. d. | Men. | Women. | Children. | Total. | |
| Styria | 34 | 14 | 280,938 | 85,262 | 0 7 | 1,854 | 52 | 59 | 1,915 | 146·7 |
| Carinthia | 10 | 8 | 113,687 | 49,227 | 0 10 | 1,188 | 11 | .. | 1,199 | 94·8 |
| Bohemia | 108 | 31 | 69,281 | 16,860 | 0 6 | 938 | 2 | 2 | 942 | 74·6 |
| Moravia | 22 | 12 | 60,514 | 28,875 | 0 11 | 488 | .. | 20 | 508 | 119·1 |
| Carniola | 19 | 10 | 9,806 | 6,575 | 1 4 | 324 | 6 | .. | 330 | 29·7 |
| Silesia | 11 | 4 | 8,106 | 4,386 | 1 1 | 350 | .. | .. | 350 | 23·2 |
| Galicia | 13 | 4 | 4,559 | 1,761 | 0 9 | 196 | .. | .. | 196 | 23·2 |
| Tyrol | 7 | 3 | 3,767 | 3,402 | 1 10 | 55 | .. | .. | 55 | 68·5 |
| Salzburg | 7 | 2 | 2,758 | 845 | 0 7 | 9 | .. | .. | 9 | 306·5 |
| Bukowina | 4 | 2 | 1,454 | 682 | 0 11 | 106 | 20 | 35 | 161 | 13·0 |
| Lower Austria | 6 | 1 | 97 | 58 | 1 2 | 6 | .. | .. | 6 | 16·2 |
| Upper Austria | 2 | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Austria, Total | 243 | 91 | 554,965 | 197,033 | 0 8 | 5,464 | 91 | 116 | 5,671 | 98·7 |
| Hungary | .. | .. | 307,220 | 108,674 | 1 4 | .. | .. | .. | .. | .. |
| Transylvania | .. | .. | 37,497 | 8,646 | 0 11 | .. | .. | .. | .. | .. |
| Croatia | .. | .. | 2,739 | 1,008 | 0 9 | .. | .. | .. | .. | .. |
| Hungary, &c., Total | .. | .. | 347,456 | 118,328 | .. | .. | .. | .. | .. | .. |
| Austro-Hungary, Total | .. | .. | 902,421 | 316,261 | .. | .. | .. | .. | .. | .. |

It will be seen from this table that the Alpine countries (Styria and Carinthia) are ahead of all others in respect of the quantity of ores raised, which now equally applies to the production of *pig-iron*. In 1876 the quantity produced in these provinces was 161,273 metric tons, or 41·3% of the whole production of Austro-Hungary. This pig-iron is moreover known to be of prime quality. Unhappily it has been proved that the production of it cannot be extended to meet considerable increase of demand, as in consequence of the scarcity of well-caking mineral coal, charcoal is at present almost the exclusive fuel for smelting the ores. The high railway tariffs admit only of a limited application of caking coal from other parts. For the purpose of obviating the consequent necessity of importing considerable quantities of foreign pig-iron, many trials have been made for the purpose of using lignite as fuel for blast furnaces. Thus, for example, Fohnsdorf lignite has been in regular use at the Zeltweg works in Styria for several years, and has attained the large proportion of 44% of the entire quantity of fuel consumed there. The high quality and the consequent great demand for the ores are proved by the fact that in the course of late years (from 1873 to 1876) not inconsiderable quantities of them have been exported, principally to Germany, where first-rate coke is plentiful.

In the northern group also (Bohemia, Moravia, Silesia) the production of pig-iron was in the first instance carried on exclusively by vegetable fuel; the first coke blast-furnace there—which at the same time was the first in entire Austria—having been erected at Witkowitz as late as 1838. Since the year 1870 the use of coke for making pig-iron begins to become more general in these countries, and at present one half of their production is made by coke. The most extensive coke furnace works are those of the Prague Iron Company at Kladno.

There is certainly a great quantity of good caking coal available in these three countries, but the quality of the ores, and consequently that of the pig-iron made from them, is different and inferior to those produced in Styria. More than one-third of the entire production of these parts is foundry pig-iron.

The manufacture of pig-iron in Hungary has certainly advanced much in the course of the last few years, but a scarcity of suitable caking coal prevails here also. Only small quantities of Banatian coal are used for making coke pig-iron. The ores of the southern slope of the Carpathian mountains also are chiefly worked with charcoal, as are the Transylvanian ores.

The entire quantity of pig-iron produced in the Austro-Hungarian empire from 1840 to 1876, was as follows :—

| Year. | Production of Pig-iron. | | Castings from the Blast Furnace | |
|---|---|---|---|---|
| | Metric Tons. | Value in £. | Metric Tons. | Value in £. |
| 1840 | 127,307 | 865,212 | 17,045 | 185,462 |
| 1850 | 195,558 | 1,243,513 | 27,487 | 256,073 |
| 1860 | 312,554 | 1,943,498 | 36,244 | 371,880 |
| 1866 | 284,638 | 1,351,654 | 35,071 | 305,732 |
| 1867 | 319,902 | 1,639,762 | 41,136 | 377,125 |
| 1868 | 375,077 | 2,179,097 | 49,994 | 447,317 |
| 1869 | 405,082 | 2,451,627 | 45,485 | 430,962 |
| 1870 | 402,953 | 2,536,964 | 49,291 | 486,263 |
| 1871 | 424,606 | 2,709,217 | 52,021 | 528,565 |
| 1872 | 459,625 | 3,358,706 | 72,225 | 707,838 |
| 1873 | 534,507 | 4,097,976 | 60,473 | 607,050 |
| 1874 | 494,054 | 2,893,791 | 51,688 | 448,077 |
| 1875 | 454,574 | 2,409,489 | 49,773 | 401,701 |
| 1876 | 400,426 | 2,061,416 | 50,507 | 390,882 |

Accordingly the increase in the manufacture of pig-iron is not considerable, or at least not proportionate to the enormous increase in the wealth of the nation generally speaking.

The production of 1876 has been contributed by the different countries as shown in Table I., pages 120 and 121.

As no official returns exist in Austro-Hungary concerning the manufacture of iron and hardware—pig-iron excepted—by means of which a correct notion of the iron trade of the empire could be obtained, we can only offer a few remarks on this point which are based upon general trade statistics, taking into account the enormous increase of the railway system and of all manufacturing industries at the same time.

The import and export of iron and of the different objects manufactured from it, from 1866 to 1873, are shown by Table II., pages 120 and 121.

The rapid growth of the railway system, chiefly during the years 1870 to 1873, appears from the following figures. The total mileage of the Austro-Hungarian railways was :—

| | | | | | |
|---|---|---|---|---|---|
| In 1837 | 13 | Kilometres. | In 1870 | 9,454 | Kilometres. |
| „ 1840 | 143 | „ | „ 1871 | 11,630 | „ |
| „ 1850 | 1,510 | „ | „ 1872 | 13,746 | „ |
| „ 1860 | 4,477 | „ | „ 1873 | 15,444 | „ |
| „ 1866 | 5,962 | „ | „ 1874 | 15,912 | „ |
| „ 1867 | 6,266 | „ | „ 1875 | 16,597 | „ |
| „ 1868 | 7,005 | „ | „ 1876 | 17,464 | „ |
| „ 1869 | 7,888 | „ | „ 1877 | 18,058 | „ |

The tabular statement, Table III., on page 122, of the different works and manufactories connected with the iron industry and worked by steam power, which has been taken from the official statistical return of steam engines for 1876, mentioned before, may be of some further use for obtaining a correct notion of the present state of this industry :—

| I. Country. | Number of Works. | | Blast Furnaces. | | | Production. | | |
|---|---|---|---|---|---|---|---|---|
| | Total. | Working. | Out of Blast. | In Blast. | No. of Weeks in Blast. | Forge-pig. | Foundry-pig. | Tot |
| | | | | | | Metric Tons. | Metric Tons. | Metric |
| Styria | 22 | 20 | 8 | 28 | 1,167 | 114,335 | 2,258 | 116 |
| Carinthia | 17 | 11 | 8 | 15 | 535 | 44,232 | 448 | 44 |
| Bohemia | 34 | 14 | 34 | 17 | 694 | 22,631 | 20,566 | 43 |
| Moravia | 14 | 7 | 12 | 11 | 437 | 16,186 | 10,578 | 26 |
| Silesia | 6 | 4 | 2 | 6 | 271 | 18,395 | 2,345 | 20 |
| Lower Austria | 4 | 2 | 3 | 2 | 52 | 8,727 | 45 | 8 |
| Carniola | 11 | 6 | 3 | 7 | 167 | 3,150 | 781 | 3 |
| Tyrol | 3 | 2 | 1 | 3 | 98 | 2,531 | 718 | 3 |
| Galicia | 8 | 4 | 3 | 3 | 125 | 775 | 2,282 | 3 |
| Salzburg | 3 | 2 | 1 | 2 | 29 | 1,741 | 9 | 1 |
| Bukowina | 4 | 1 | 3 | 1 | 22 | 170 | 143 | |
| Austria, Total | 126 | 73 | 78 | 95 | 3,597 | 232,873 | 40,173 | 273 |
| Hungary | ... | ... | 29 | 56 | 2,176 | 98,873 | 9,582 | 108 |
| Transylvania | ... | ... | 6 | 12 | 230 | 17,135 | 793 | 17 |
| Croatia | ... | ... | ... | 3 | 35 | 1,038 | 9 | 1 |
| Hungary, &c., Total | ... | ... | 35 | 71 | 2,441 | 117,046 | 10,334 | 127 |
| Austro-Hungary, Total | ... | ... | 113 | 166 | 6,038 | 349,919 | 50,507 | 400 |

Import.

| II. Year. | Pig and Scrap Iron. | Rails. | Tires. | Steel of all descriptions. | Steel Plates, Sheets, and Wire. | Bar, Hoop, &c., Iron. | Plates, Sheets, Wire, and Sectional Iron. | Heavy Castings. | Hardware. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Metric Tons. | | | | | | | | | |
| 1866 | 3,628 | 165 | 495 | 132 | 105 | 251 | 375 | 665 | 1,538 | |
| 1867 | 14,731 | 25 | 519 | 214 | 208 | 171 | 798 | 1,335 | 2,079 | |
| 1868 | 131,351 | 54,218 | 2,322 | 636 | 401 | 9,731 | 9,753 | 2,802 | 7,451 | |
| 1869 | 154,614 | 114,931 | 3,628 | 936 | 379 | 19,253 | 13,781 | 10,870 | 26,790 | |
| 1870 | 161,008 | 116,813 | 1,774 | 848 | 986 | 13,556 | 12,166 | 8,795 | 31,514 | |
| 1871 | 193,338 | 101,302 | 1,190 | 1,127 | 512 | 22,581 | 18,268 | 11,146 | 29,291 | |
| 1872 | 219,078 | 65,839 | 1,795 | 1,111 | 439 | 27,880 | 23,706 | 14,779 | 29,268 | |
| 1873 | 177,607 | 52,481 | 767 | 641 | 539 | 13,640 | 17,157 | 13,268 | 29,949 | |
| 1874 | 478,869 | 10,110 | 475 | 371 | 150 | 3,836 | 4,467 | 6,676 | 20,490 | |
| 1875 | 56,145 | 1,345 | 681 | 795 | 152 | 3,547 | 3,516 | 3,856 | 8,060 | |
| 1876 | 38,057 | 805 | 630 | 880 | 185 | 1,458 | 2,590 | 3,117 | 6,503 | |
| | Value in £. | | | | | | | | | |
| 1866 | 17,441 | 1,950 | 6,909 | 7,799 | 8,036 | 3,196 | 10,613 | 11,715 | 242,181 | 2 |
| 1867 | 72,038 | 298 | 7,625 | 12,569 | 13,751 | 2,181 | 19,916 | 23,492 | 346,599 | 3 |
| 1868 | 642,464 | 530,259 | 34,071 | 26,433 | 23,116 | 123,731 | 216,517 | 52,849 | 742,173 | 6 |
| 1869 | 756,067 | 1,123,933 | 53,226 | 28,692 | 23,434 | 244,823 | 296,711 | 191,355 | 1,322,111 | 8 |
| 1870 | 787,331 | 1,142,431 | 26,024 | 25,668 | 53,312 | 172,359 | 264,142 | 154,833 | 1,376,362 | 1,0 |
| 1871 | 945,426 | 990,736 | 17,471 | 33,808 | 38,529 | 287,102 | 385,198 | 196,216 | 1,022,505 | 1,3 |
| 1872 | 1,069,533 | 643,906 | 26,339 | 32,952 | 25,970 | 354,475 | 506,985 | 259,684 | 1,736,877 | 1,5 |
| 1873 | 868,500 | 513,271 | 11,326 | 18,707 | 32,092 | 173,428 | 364,540 | 233,586 | 1,744,953 | 1,3 |
| 1874 | 280,911 | 98,876 | 11,160 | 14,484 | 8,967 | 41,269 | 85,036 | 84,882 | 1,009,781 | 9 |
| 1875 | 274,552 | 12,628 | 16,006 | 22,878 | 6,582 | 32,962 | 61,156 | 41,489 | 706,985 | 8 |
| 1876 | 156,323 | 6,697 | 14,801 | 22,947 | 8,108 | 9,981 | 29,789 | 23,542 | 571,552 | 5 |

| Value. | | | Average price per 59 kil. at the Works. | | Number of Workpeople. | | | | Metric Tons of Pig-iron produced per head of Workpeople. |
|---|---|---|---|---|---|---|---|---|---|
| e-pig. | Foundry-pig. | Total. | Forge-pig. | Foundry-pig. | Men. | Women | Children. | Total. | |
| £. | £. | £. | s. d. | s. d. | | | | | |
| 3,906 | 21,027 | 579 933 | 4 11 | 9 4 | 884 | 64 | 15 | 963 | 121·1 |
| 0,889 | 3,530 | 224,419 | 5 0 | 7 11 | 498 | 23 | 2 | 523 | 85·4 |
| 3,418 | 143,961 | 262,379 | 5 3 | 7 0 | 2,773 | 48 | 150 | 2,971 | 14·5 |
| 3,433 | 69,844 | 166,277 | 5 11 | 6 7 | 1,151 | 48 | 23 | 1,222 | 21·9 |
| 7,039 | 23,768 | 110,807 | 4 9 | 10 2 | 962 | 2 | 10 | 974 | 21·3 |
| 2,711 | 212 | 42,923 | 4 11 | 4 8 | 83 | ... | ... | 83 | 105·7 |
| 7,051 | 5,043 | 32,094 | 8 7 | 6 5 | 313 | 4 | ... | 317 | 12·4 |
| 5,054 | 8,244 | 24,298 | 6 4 | 11 6 | 169 | ... | ... | 169 | 19·2 |
| 949 | 25,870 | 26,819 | 1 3 | 11 4 | 452 | 6 | ... | 458 | 6·7 |
| 3,892 | 60 | 8,952 | 5 1 | 6 5 | 10 | 1 | ... | 11 | 159·1 |
| 1,678 | 2,031. | 3,709 | 9 11 | 14 2 | 49 | ... | ... | 49 | 6·4 |
| 9,020 | 303,590 | 1,482,610 | 5 1 | 7 7 | 7,344 | 196 | 200 | 7,740 | 35·3 |
| 7,602 | 79,162 | 486,764 | 4 2 | 8 4 | ... | ... | ... | ... | ... |
| 0,258 | 7,947 | 88,205 | 4 8 | 10 0 | ... | ... | ... | ... | ... |
| 3,802 | 35 | 3,837 | 3 8 | 5 10 | ... | ... | ... | ... | ... |
| 1,662 | 87,144 | 578,806 | 4 2 | 8 1 | ... | ... | ... | ... | ... |
| 0,682 | 390,734 | 2,061,416 | ..... | ..... | ... | ... | ... | ... | ... |

## Export.

| Pig and Scrap-Iron. | Rails. | Tires. | Steel of all descriptions. | Steel Plates, Sheets, and Wire. | Bar, Hoop, &c., Iron. | Plates, Sheets, Wire, and Sectional Iron. | Heavy Castings. | Hardware. | Engines and Machinery. |
|---|---|---|---|---|---|---|---|---|---|
| Metric Tons. | | | | | | | | | |
| 3,561 | 246 | .. | 3,986 | 30 | 4,656 | 2,501 | 4,451 | 6,849 | 2,289 |
| 1,095 | 109 | .. | 4,014 | 40 | 7,743 | 3,664 | 2,799 | 8,670 | 7,270 |
| 1,033 | 41 | 13 | 3,162 | 411 | 4,175 | 3,183 | 2,951 | 8,416 | 2,926 |
| 524 | 93 | 2 | 3,610 | 7 | 4,555 | 2,928 | 2,947 | 10,206 | 2,192 |
| 342 | 58 | .. | 3,546 | 94 | 3,855 | 2,245 | 1,447 | 9,197 | 1,286 |
| 567 | 220 | .. | 3,584 | 10 | 2,443 | 1,725 | 901 | 10,731 | 3,841 |
| 1,393 | 237 | 21 | 3,618 | 106 | 2,549 | 2,307 | 1,321 | 11,471 | 3,200 |
| 2,065 | 712 | 1 | 3,217 | 114 | 2,668 | 1,849 | 1,061 | 10,042 | 7,484 |
| 5,689 | 7,795 | 243 | 4,215 | 22 | 5,650 | 3,380 | 2,959 | 13,009 | 13,877 |
| 10,727 | 10,774 | 199 | 4,223 | 142 | 7,056 | 3,568 | 2,077 | 15,636 | 11,847 |
| 7,317 | 4,325 | 40 | 3,843 | 428 | 8,304 | 4,107 | 2,100 | 13,898 | 6,028 |
| Value in £. | | | | | | | | | |
| 20,896 | 3,654 | .. | 154,950 | 1,863 | 72,865 | 55,077 | 78,357 | 657,056 | 106,357 |
| 6,357 | 1,598 | .. | 157,032 | 2,269 | 121,168 | 79,634 | 49,280 | 826,991 | 327,563 |
| 6,064 | 596 | 199 | 123,639 | 20,641 | 65,258 | 68,168 | 52,045 | 838,214 | 157,371 |
| 3,077 | 1,373 | 34 | 141,225 | 900 | 71,272 | 55,912 | 51,883 | 1,059,623 | 93,853 |
| 2,006 | 854 | .. | 138,700 | 5,100 | 60,329 | 58,312 | 25,469 | 1,047,111 | 56,538 |
| 3,330 | 3,234 | .. | 140,192 | 1,003 | 38,227 | 36,084 | 15,867 | 1,218,849 | 223,606 |
| 8,174 | 3,486 | 312 | 141,530 | 6,095 | 39,894 | 48,472 | 23,252 | 1,288,345 | 142,846 |
| 12,115 | 10,453 | 15 | 125,859 | 6,410 | 41,742 | 39,669 | 18,671 | 1,176,470 | 422,028 |
| 33,386 | 125,797 | 3,545 | 123,680 | 958 | 82,889 | 77,828 | 40,514 | 1,575,240 | 799,505 |
| 58,751 | 153,845 | 3,890 | 123,900 | 3,180 | 93,155 | 68,323 | 24,377 | 1,700,673 | 571,183 |
| 38,646 | 60,910 | 637 | 105,231 | 8,581 | 97,457 | 71,787 | 24,656 | 1,456,778 | 245,531 |

| III. Works. | Austria (excl. Hngary.) | | Bohemia. | | Moravia. | | Lower Austria. | | Styria. | | Carinthia. | | Silesia. | | Other Countries. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Works. | Boilers. | Works. | Boilers. | Works. | Boilers. | Works. | Boilers. | Works. | Boilers. | Works. | Boilers. | Works. | Boilers. | Works. | Boilers. |
| Furnace Works | 27 | 107 | 3 | 4 | 8 | 31 | 2 | 18 | 9 | 43 | 4 | 9 | .. | .. | 1 | 2 |
| Ironworks | 29 | 265 | 8 | 42 | 7 | 129 | 3 | 4 | 2 | 27 | 4 | 11 | 4 | 51 | 1 | 1 |
| Ironfoundries | 28 | 30 | 10 | 10 | 1 | 1 | 8 | 8 | 3 | 5 | .. | .. | 2 | 2 | 4 | 4 |
| Iron and Steel Rolling Mills | 53 | 508 | 14 | 138 | 1 | 20 | 3 | 65 | 27 | 228 | 4 | 32 | 3 | 21 | 1 | 4 |
| Lock, &c., Manufactories | 25 | 29 | 8 | 9 | 4 | 4 | 8 | 9 | 2 | 3 | .. | .. | 1 | 2 | 2 | 2 |
| Wire-nail and Wire Works | 31 | 35 | 5 | 6 | 4 | 6 | 8 | 8 | 10 | 11 | .. | .. | 2 | 2 | 2 | 2 |
| Brass, &c., Works | 36 | 62 | 13 | 16 | 2 | 12 | 13 | 30 | 2 | 2 | .. | .. | 1 | 2 | .. | .. |
| Hardware, &c., Manufactories | 28 | 36 | 9 | 9 | 7 | 9 | 10 | 16 | .. | .. | .. | .. | 2 | 2 | .. | .. |
| Engine Works | 122 | 242 | 39 | 57 | 16 | 30 | 39 | 75 | 3 | 16 | 2 | 8 | 7 | 9 | 16 | 52 |
| Repairing, &c., Shops | 71 | 136 | 27 | 40 | 7 | 8 | 15 | 46 | 4 | 13 | .. | .. | 1 | 1 | 17 | 28 |

In the perusal of these returns we are struck in the first instance by the enormous figures of the import, chiefly in the years 1868 to 1873, when the general activity in railway construction and in all branches of industry was forced up to so high a pitch, and when the demands upon the iron industry were so extraordinary that it appeared impossible to complete the enormous orders of rails, tires, bridgework, castings of all kinds, &c. Notwithstanding the greatest exertions of the inland works—which for the greatest part were either not completely fitted up or were in course of construction—only a small portion of this entirely unforeseen demand could be satisfied, and thus the parties concerned were by necessity thrown back on the resources of foreign countries. The sudden and rapid decline of the import, consequent upon the completion of the great railway lines and the well-known general crisis, is clearly indicated by the tables.

This may be the proper place to give a short account of the different branches of the iron industry.

As to *pig-iron* in the first place, the import in 1872 attained the enormous figure of 219,078 metric tons, of a value of £1,069,533. This considerable import, principally effected by Germany, England, and Belgium, was not due to a normal state of business, but to the excessive activity in railway construction. At present the demand for iron in Austria is much smaller, and may easily be satisfied by the home production.

*Wrought-iron* was formerly made from pig by the old process, in open fires and with charcoal, which method, however, is now entirely changed for puddling, the use of charcoal having at the same time been superseded by mineral coal, peat, and gas. The greatest quantity of wrought-iron is made in Styria, Bohemia, Moravia, and Lower Austria. Instead of the enormous quantities of wrought-iron imported during the years 1869 to 1873 (amounting in 1872 alone to 27,880 metric tons, of a value of £354,475), scarcely any at all has been imported since 1876, and the quantity sent out of the country has considerably increased.

Of *plates*, *sheets*, and *wire* considerable quantities had to be imported into Austria, as an adequate number of the ironworks engaged in this trade were still wanting, and enormous sums of money had accordingly to be paid to foreign countries (in 1872, £506,985).

The quantity of *castings* produced, as far as concerns those made direct from the blast-furnace, has been already stated in the table referring to the production

of pig-iron. A number of Austrian foundries have been induced to engage in the manufacture of high-class castings on account of the excellent quality of the native ores, and have proved able to export their productions, which are very favourably known for their strength and durability. The greatest number as well as the greatest production of foundries is to be found in Bohemia and in Lower Austria.

The quantity of *heavy castings* imported was very considerable during the former active period, but has since fallen off nearly to the level of the export. In *hardware* there has even been a very satisfactory increase of the amount exported, which has already attained the important figure of £1,400,000. As these products are made from a first-rate material, they will also in future obtain a ready and profitable sale; hitherto they have been sent to Germany, Russia, Italy, Roumania, and Turkey.

In consequence of the great abundance of a cheap and excellent fuel (Bohemian lignite), and of good ores, the conversion of pig-iron into wrought-iron and steel and the manufacture of high-class hardware are the most promising branches of Austrian iron industry. This applies principally to the manufacture of a prime description of *steel*, of which far-famed material the greatest part has hitherto been sold in the Oriental countries.

The first rank in steel manufacture is occupied by Styria and Carinthia, where, only forty years ago, more than 15,000 metric tons of German steel were made per annum. But in spite of the high prices obtained for export the extent of this manufacture had to be restricted, as competition became more and more difficult in consequence of the rising price of wood and the increasing general cost of production. Besides, the increasing application of the Bessemer process—which has entirely changed the state of steel manufacture—is tending to a steady diminution of the manufacture of German steel in open hearths.

Puddled steel, which formerly was much used for rails, is at present only made in small quantities. The first puddling furnaces in Austria were erected at Witkowitz in 1829. Austrian cast-steel, which is chiefly made in Upper Styria, is of a well-known high quality. Martin steel is only made at a few works, as, for instance, at those of the Southern Railway at Graz.

The imported quantity of steel and steel hardware is very insignificant, for in this respect Austria is able to supply her home demand and even to expors fair quantities. Among the steel hardware, scythes, sickles, and chopping-bladet may be named, scythes being made at the rate of six millions per annum, a great portion of which is exported.

The production of *Bessemer steel* is of great importance in Austria at present, and still more promising for the future. The Austrian steel manufacturers are ahead of their Continental rivals as well as regards the quality and relative quantity of their Bessemer steel as the technical perfection in carrying out the process, and are likely to retain their place for the future.*

The erection of the first Bessemer works in Austria was begun in the year 1862 at Turrach, in Upper Styria; their number has since increased to 13, having between them 32 converters. The most important are at present the Ternitz works in Lower Austria, having 6 converters. The average quantity of steel made by each "blow" is about 3½ metric tons.

The entire production of Bessemer steel in Austria, from the first introduction of the process until the end of 1877, has been as follows:—

* Tunner, Das Eisen-Berg-und Hüttenwesen der Alpenländer.

| Locality of Bessemer Works | Bohemia | | Moravia. | Silesia. | Lower Austria. | Styria. | | | | | Carinthia. | | Hungary. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Teplitz. | Kladno. | Witkowitz. | Teschen. | Ternitz. | Turnach. | Neuberg. | Graz (Southern Railway). | Zeltweg. | Graz (State Railway). | Heft. | Prevali | Resicza. | |
| Date of opening. | May 1873 | Sept., 1875. | May, 1866. | Jany., 1875. | June, 1868. | Nov., 1863. | Feb., 1865. | Jany., 1865. | Sept., 1871. | May, 1873. | July, 1864. | March 1876. | Dec., 1868. | |
| Number of Converters. | 2 | 2 | 3 | 2 | 6 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 32 |
| Year. | Metric Tons. | | | | | | | | | | | | | |
| 1864 .. | .. | .. | .. | .. | .. | 109 | .. | .. | .. | .. | 197 | .. | .. | 306 |
| 1865 .. | .. | .. | .. | .. | .. | 211 | 704 | 1,895 | .. | .. | 645 | .. | .. | 3,545 |
| 1866 .. | .. | .. | 524 | .. | .. | 308 | 1,718 | 2,906 | .. | .. | 1,379 | .. | .. | 6,835 |
| 1867 .. | .. | .. | 1,585 | .. | .. | 724 | 2,824 | 2,396 | .. | .. | 1,236 | .. | .. | 8,765 |
| 1868 .. | .. | .. | 2,727 | .. | 3,346 | 547 | 3,090 | 3,294 | .. | .. | 1,304 | .. | 287 | 14,495 |
| 1869 .. | .. | .. | 3,230 | .. | 7,144 | 464 | 3,112 | 3,166 | .. | .. | 1,217 | .. | 2,389 | 20,722 |
| 1870 .. | .. | .. | 3,200 | .. | 6,055 | 607 | 3,980 | 3,878 | .. | .. | 764 | .. | 3,628 | 22,112 |
| 1871 .. | .. | .. | 3,278 | .. | 10,565 | 1,145 | 5,261 | 4,577 | 1,327 | .. | 3,102 | .. | 6,257 | 35,512 |
| 1872 .. | .. | .. | 3,800 | .. | 20,514 | 901 | 5,697 | 5,063 | 7,142 | .. | 5,189 | .. | 7,098 | 55,404 |
| 1873 .. | 2,934 | .. | 5,570 | .. | 29,849 | 1,432 | 4,435 | 4,503 | 9,480 | 1,990 | 7,588 | .. | 9,040 | 76,821 |
| 1874 .. | 9,963 | .. | 6,630 | .. | 34,127 | 897 | 3,607 | 3,659 | 11,358 | 7,255 | 10,160 | .. | 9,302 | 96,958 |
| 1875 .. | 9,270 | 921 | 7,197 | 3,163 | 19,395 | 1,081 | 3,238 | 3,710 | 7,480 | 11,335 | 10,613 | .. | 13,203 | 87,443 |
| 1876 .. | 11,835 | 7,635 | 2,734 | 5,113 | 15,606 | 1,419 | 3,834 | 5,196 | 6,653 | 3,350 | 9,192 | 340 | 22,132 | 89,926 |
| 1877 .. | 12,235 | 8,913 | 12,280 | 5,252 | 14,403 | 1,267 | 3,602 | .. | 10,530 | .. | 10,801 | 5,793 | 17,646 | 97,470 |

In Hungary there is as yet only one single Bessemer works, that of the Imperial State Railways at Resicza. According to the foregoing table the production of Bessemer steel has somewhat lagged behind of late years, which, however, is quite natural, considering the present state of trade.

The manufacture of *rails* has greatly advanced in Austria. As has been stated above, considerable quantities of rails had to be purchased during the years 1868 and 1873 from Belgium and Germany, in spite of new rolling-mills having at that time been erected about Ternitz, Graz, and Teplitz. The quantity of rails imported reached its highest amount of 116,813 metric tons, worth £1,142,431, in the year 1870. But these exceptional times are past—there is now-a-days no question of an import of rails into Austria, the wants of the Austrian railways being entirely satisfied by the mills in their own country. These wants are, moreover, not equalling the productive power of the inland rail-mills just now, but in this respect Austria is in a less critical situation than other countries. The actual low prices of rails are no doubt indicative of a want of sufficient orders, from which the entire Austrian iron trade is suffering at present.

At the end of 1877 there were 17 rail mills in Austro-Hungary, the total production of which will be seen from the following table :—

| Year. | Iron Rails. | Steel Rails. | Total. |
|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. |
| 1870..... | 89,790 | 17,307 | 107,097 |
| 1871..... | 90,463 | 23,199 | 113,662 |
| 1872..... | 86,556 | 38,009 | 124,565 |
| 1873..... | 80,742 | 50,327 | 131,069 |
| 1874..... .. | 54,797 | 57,169 | 111,966 |
| 1875..... | 40,155 | 61,345 | 101,500 |
| 1876..... | 22,819 | 64,491 | 87,310 |
| 1877..... | 18,645 | 79,065 | 97,710 |

These figures prove sufficiently how rapidly iron rails are being superseded by steel.

It must be concluded from the above remarks that the Austrian iron industry, like that of other countries, is at present very sensibly affected by the general stagnation of trade.

But it may be foretold with the utmost certainty that a better future is in store for it, and that it has attained a high state of efficiency, owing to the considerable increase of the works in extent as well as in number, to their excellent outfit, and to the existing low rate of wages. Accordingly it would not seem likely that such large sums of money would ever again be paid to foreign countries for iron as has been the case during the sudden and heavy demand from 1870 to 1872, when a moderate tariff was moreover instrumental in promoting importation. The Austrian iron trade is at present prepared to meet any demand arising from a general revival of trade, an adequate protective tariff always supposed to be retained, which, on account of the otherwise unfavourable conditions of production, cannot be dispensed with. Several branches of this industry, being favourably conditioned for manufacturing first-class goods, will be able to export them, and, after supplying the home demand, to sell the remainder of their production to Italy, Turkey, the Danubian Principalities, and Russia, which countries, being less advanced and not so much favoured by nature, are at present purchasing the greater part of their iron and hardware from England.

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# RUSSIA.

## 4,909,194 SQUARE KILOMETRES. 65,704,559 INHABITANTS.

MINING operations have been carried on in the Caucasus, Ural, Altai, and the Kirghise desert in the most remote ages. This is proved by the number of abandoned workings discovered by the Russians when they took possession of these districts. These conquerors, however, did not recommence their working before the fifteenth century, from which time there was again a lapse of three hundred years before order and progress were firmly established by new mining legislation issued by PETER THE GREAT, in 1719. Since then mining in Russia has acquired more and more independence, and owing to the protection by the Government, and chiefly to the new mining laws of 1868,* this important branch of national industry is quite as much in a state befitting modern civilisation as in the most advanced countries of Europe.

All mines and ironworks are, according to the mode of *tenure o the land* upon which they are carried on, divided into (1) works owned by the Crown; (2) private possessions of the Emperor; (3) "Proprietary works;" (4) private works on land owned by the Crown; (5) private works on private land. Besides this they are, according to their situation, divided into *mining districts*, which however have recently undergone some alterations. The mining laws lately projected for Russia have been based as much as possible upon the same principles as the Prussian mining laws dating from June 24th, 1865, the only important difference consisting of the right of forestalment as to getting underground minerals being conferred by the Russian laws upon the proprietor of the soil instead of, as in Prussia, upon the finder. Almost all minerals and fossil substances are subjected

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* These laws were separately issued. The whole of them are to be found in the Common Code (Swod sakonof) of 1857, Vol. VII., and a collection of them is contained in the "Zeitschrift für Bergrecht," Vol. XII., 1871, pp. 417 to 414, by BRASSERT.

to the mining laws as well as to the supervision of the Government—as, for instance, every description of ore, metal, mineral fuel, salt, earth, and stone.

For the *kingdom of Poland* special mining laws, dated from June 16th and 28th, 1870, have been issued and afterwards completed by several supplementary additions and instructions for execution, but they do not appear to meet the exigencies and wishes of the parties concerned. Thus much is known at least, that several wishes for a change of these mining laws have lately been brought to the cognisance of the higher officials, as for instance, to leave the *consolidation* of mining property to the option of the owners; to give to the mining authorities the privilege of prolonging the lease of new mines; to grant to the mine-owners the necessary power of *appropriating* land wanted for the construction of roads, railways, &c.; to remove the stringent prescriptions concerning the use of *blasting-powder* in mines; to arrange better *indemnifications of landowners* for the minerals gained under their surface.

These desires alone, to which the other districts of the empire are quite as well entitled, are a sufficient proof that the existing mining laws do not offer the necessary encouragement and protection for developing the great mineral resources of this vast empire.

Other impediments must be mentioned; for example, the absence of proper means of communication by water as well as by land; an excessive over-taxation inflicted upon waterways and railroads; before all, however, the greatly *prohibitive tariff* and the *payment in gold* exacted for all tolls and import duties, by which exports and foreign trade in general are exceedingly hampered; lastly, the *vexatious enactments* imposed upon industrial and commercial enterprise by giving a monopoly to a certain number of people with one hand, and by imposing such a burden of taxes and duties upon them with the other, that the price of each article produced and consumed, the costs of transport and of general commercial intercourse are increased to a far greater extent as to benefit the general community.

Under such conditions the mining and iron industries have, of course, not been developed sufficiently to suit the wants of that vast country, and great as the increase in the production of both industries has been compared to their previous standard, yet this production, compared with the existing home demand, and still more so with the production of other mining countries, is still quite insufficient, as will be shown further on.

## COAL.

In consequence of a supposed abundance of forests and firewood, coal-mining in Russia, the same as in Sweden, has not met with the attention to which the production of a cheaper and better fuel is entitled, even in countries where no scarcity of wood has as yet been perceivable.

The extent of the Russian forests, even at present, is still enormous. Their total area (Poland and Finland included) is stated to be as much as 193 millions of dessjatines = 2·108 millions of square kilometres, or 40 per cent of the total area of European Russia. This abundance of wood, however, is very unequally distributed over the different parts of the country, some provinces possessing forests at the rate of millions of dessjatines, and other parts being entirely woodless deserts of equal extent.

By a single glance at the returns of the Russian coal and iron trade (as compiled later on from the latest and most reliable official publications) we perceive at once that Russia, next to Turkey, holds the lowest rank amongst the iron and coal producing countries of Europe, considering the proportion of the production to the immense extent of the country and its vast population.

That the *existing Russian forests* are insufficient to supply an equally increasing demand of fuel for domestic, industrial, and railway purposes has been proved in the manufacturing districts of the country. Our space does not allow

of bringing forward evidence of this fact, which, however, is well known to all parties concerned.

In the first place, coal ought to be expected to replace the diminishing supply of wood. But coal does not exist in such quantities in Russia as is generally supposed, the mineral wealth of that country in this respect being frequently estimated beyond its real value.

Respecting the *Donetz* mining district, Herr J. VON BOCK, whose publications concerning the Russian coal and iron trade are of great value and have been frequently used in this treatise, gives his opinion in the *Russian Review*, 1874, page 34, as follows :—

"The Donetz coal measures are, in respect to their extent, ranking amongst the most important known; they exceed in this respect all coal measures of Western Europe, and are only second to those of North America.

"According to an approximate calculation the Donetz mountain range contains 8,271 millions of cubic metres, or 10,751 millions of metric tons of coal and anthracite. This enormous deposit may be exhausted no sooner than in 35,000 years by an output of 300,000 metric tons per annum; if it should be worked at a rate which, for instance, is usual in Prussia, it would only last 900 years."

The Donetz coal measures, extending over an area of rather more than 27,312 square kilometres, are certainly larger than any coal measures of Europe; but the seams being but of little thickness, an output like that from the enormous deposits of England, Belgium, Germany, &c., cannot be reached.

The measures extend over a tableland 244 metres high, formed by the Donetz mountain ranges, with deep ravines called Balki. The coalfield has a length of 368 and a breadth of 160 kilometres, and an area of 27,312 square kilometres.

The mines of the district are divided into a *western* and a *southern group*, between which there is a further difference as regards the quality of their coal.

The first group is situated in the southern portion of the Department of Charkow and in the Bachmutch and Sslawanoserbsh districts of the Jekaterinosslaw Department. Besides a few ore mines, *coal* only is to be found here.

The southern group, on the contrary, chiefly contains *anthracite*. Its situation is in the country of the Don Cossacks, the districts of Donetz, Mius, Tsherkask, and the first Don district. In that part of the country lying between both groups on the sources of the rivers Mius, Bolshaja, Kamenka, and of the tributaries of the Lugan, coal as well as anthracite is found. The quality is of a very unequal description, but still the produce is used for domestic and for many industrial purposes in factories, forges, ironworks, lime, gypsum, and brickworks.

Donetz coal is exported in limited quantities only, as the price of it is rather high and means of transport are scarce. A cubic fathom (=9·71 cubic metres) of firwood is equivalent to 72 pud (1,179 kilo.) of Donetz anthracite; 100 pud (1,638 kilo.) of Newcastle or Perm Wsewolodskiis coal are equivalent to 70 pud (1,147 kilo.) of Donetz anthracite, and 100 pud (1,638 kilo.) of Cardiff coal to 80 pud (1,310 kilo.) of anthracite. Donetz coal is sold at the pit's mouth at 4 kopeks, and anthracite at 6 kopeks per pud (10d. and 14d. per metric cwt.). At a price of 20 kopeks per pud (3s. 11d. per metric cwt.) Donetz anthracite is still used with advantage by Wolga steamers going as far as Astrachan, and at 17 kopeks (3s. 4d. per metric cwt.) as far as Nishnij-Nowgorod. At a price of 20 kopeks per pud in Odessa it competes successfully with English coal on the Euxine and the Azoff Sea. The *caloric equivalent* of the Donetz coal varies considerably. It is from 7,238 to 7,705 caloric units for anthracite, and from 4,697 to 7,970 for coal.

The other coal districts of Russia are as follows: The district of the *Vistula*, or the *western* district, in the Department of Piotrkow (kingdom of Poland); the *Moscow* or *Central Russian* district, in the Tula, Kaluga, Ssmolensk, Moscow, Rjasan, Twer, and Nowgorod Departments; the *Ural* or *eastern* district, in the

Department of Perm; in *Asiatic Russia* the *Kusnetsk* district, in the Tomsk Department; the district of the *Kirghise desert*, in the provinces of Akmolinsk and Semipalatinsk; and the *Turkestan* district, in the Sir Darja territory.

All these districts belong to the *carboniferous system*. Besides these the following remain to be mentioned as belonging to the *jurassic and cretaceous systems*, the coal and *shale deposits* of the *Caucasus*, in the Kuban and Daghestan districts, and the coal seams in the Department of *Orenburg*; to the *tertiary system* belong the lignite deposits in the Kijew and Chersson Departments, the coal beds of the *island of Saghalien*, and of the *coast district of the Pacific*.

Apart from the Donetz coalfield the only important districts are those of the *Vistula* and of *Moscow*.

The Vistula district is contiguous to that of Upper Silesia, as regards its situation as well as the quantity of coal it contains. In the concessions owned by the Crown alone a quantity of 516,000,000 pud (=8,500,000 metric tons) is said to exist. The most important portion of them (that near Dombrowa) has of late become private property. The price of coal at the pit's mouth varies from 3 to 4 kopeks per pud (7d. to 10d. per metric cwt.), and its sale is chiefly confined to the factories, ironworks, and other places of consumption in the immediate neighbourhood.

The *Moscow* coal district extends over an area of 20,000 square wersts (=22,800 square kilometres). From the coal-measures of the above-mentioned departments a narrow ridge of carboniferous limestone extends towards the north across the Olonetz and Archangelsk Departments, nearly down to the White Sea. The best seams are usually found near the extremities of the district, the more central portions being of too little thickness and of too great depth to allow of their working with any profit. The first coal-seam in the district was discovered in 1766. Mining operations commenced in 1796, and during the last twenty years the concessions have been and are now in private hands. As regards quality as well as outward appearance the Moscow coal is very similar to lignite; it contains a large percentage of ashes, and only from 3,220 to 4,128 caloric units. Nevertheless it is applied to all heating purposes, and meets with a ready sale in the centre of Russia, all the more as the supply of firewood declines and the price of it rises. The descriptions of coal mined at Murajewna (in the Dankow district of the Rjasan Department), and at Abidi (in the Alexin district of the Tula Department), are in good demand for gasworks. They are said to be very similar to the Scotch Boghead coal.

The other districts are of less importance as regards the quantity as well as the quality of their productions.

The increase of the mining industry in the several districts is exhibited by the following returns of the productions :—

| Districts. | 1867. | 1871. | 1872. | 1873. | 1874. | 1875. |
|---|---|---|---|---|---|---|
| | Met. Tons. | Met. Tons. | Met. Tons. | Met. Tons. | Met. Tons. | Met. Tons. |
| Moscow | 38,374 | 142,140 | 148,204 | 150,700 | 242,746 | 387,538 |
| Kijew-Jelissawetgrad | 1,311 | 16,380 | 14,913 | 26,209 | 22,363 | 17,906 |
| Donetz | 152,157 | 335,147 | 604,558 | 618,655 | 635,083 | 842,558 |
| Ural | 9,198 | 13,635 | 11,189 | 15,932 | 20,047 | 20,949 |
| Vistula | 223,675 | 301,553 | 283,201 | 335,725 | 402,153 | 407,935 |
| Caucasus | 3,604 | 3,160 | 3,130 | 3,538 | 3,653 | 6,177 |
| Kusnetsk | 4,095 | 3,735 | 4,589 | 5,172 | 5,818 | 4,201 |
| Kirghise Desert | 4,406 | 4,886 | 10,070 | 8,131 | 11,007 | 13,636 |
| Turkestan | ... | 1,229 | 1,595 | 6,613 | 6,809 | 6,798 |
| Island of Saghalien | 2,115 | 4,847 | 1,672 | 1,942 | 2,965 | 1,571 |
| Total | 437,625 | 829,745 | 1,0978,64 | 1,170,979 | 1,369,025 | 1,709,269 |

According to this, the greatest increase in the production has taken place in the Moscow district, which however has been far surpassed by the Donetz district as regards the quantity.

Of the whole production of the year 1875, 5,580,600 pud (=91,413 metric tons) have been raised from the mines owned by the crown and the Emperor, namely, 70,400 pud (=1,153 metric tons) in the Donetz district (Jekaterinosslaw Department); 4,857,852 pud (=79,574 metric tons) in the Vistula district (Piotrkow Department); 300,000 pud (=4,914 metric tons) in the Kuban district (Caucasus); and 95,898 pud (=1,571 metric tons) on the Island of Saghalien—all these works being the property of the crown. The private mining property of the Emperor is situated in the Kusnetsk district (Tomsk Department), and the output of the mines belonging to it was 256,450 pud (=4,201 metric tons) in 1875.

In the year 1875 the total number of mines amounted to 504, of which however only 180 were actually worked.

The table on page 130 contains a review of the most important statistical returns of the coal mining industry in the several Departments of Russia.

As the *quality* of coal varies greatly even within a single district, *analyses* of coal are only of a limited and local value. Thus the composition of the Donetz and the Ural coal varies in the following manner:—

*Anthracite* contains from 84·25 to 95·38 % of carbon; from 2·25 to 3·69 % of hydrogen; from 3·50 to 6·48 % of oxygen and nitrogen, and from 1·10 to 8·56 % of ashes. *Coal* contains from 74·18 to 88·83% of carbon; from 3·40 to 5·79% hydrogen, from 5·98 to 15·12% of oxygen and nitrogen, and from 0·74 to 6·36% of ashes.

From a number of analyses of coal from the *Vistula* district (Poland), the following extremes have been found: carbon, from 65·49 to 79·00 %; hydrogen, from 4·53 to 5·78 %; oxygen and nitrogen, from 11·98 to 28·24%, and ashes, 2·31 to 4·16 %.

The theoretical heating power of Donetz and Ural anthracite varies from 6,963 to 7,682, that of coal of the same district from 6,336 to 8,269, and that of Vistula coal from 5,743 to 7,696 caloric units,—the *available heating-power* varying in the case of Russian coal generally speaking from 60 to 66 % of its theoretical value.

Differences of equal magnitude are found amongst the several descriptions of Russian coal, if applied to *cokeing* or *gas-making*. The return of coke varies, in the case of Donetz coal, from 51·75 to 81·99 %, the latter figure being attained by the Nishnij-Chanjonkoffskij, and the former by the Pleshtshejeffskij coal.

The *market* of the Russian coal is, as a matter of course, confined to the vicinity of the coal districts, as the production falls far short of the demand, and as carriage to some distance becomes impossible by the insufficiency and the high rates of freight of the existing means of communication.

The Russian railway system may certainly appear very extensive in different parts of the vast empire, and it may be supported and supplemented in a very efficient manner by river and canal navigation, yet the total traffic circulating all over the country is but small; nor is it increased in the summer time, when the transport on common roads ceases to be facilitated by snow-tracks and sledges, as is the case during the winter. The insufficiency in means of communication is apparent at first sight if we compare the amount of traffic by rail and by water, and the immense area and the vast population of Russia to those of other countries, and this quite accounts for the limited area that can possibly be supplied with coal, and also for the comparatively insignificant production of it. It is however due to the Russian government to point out that it makes the greatest efforts for completing the railway system of the country. The aggregate mileage of railways, amounting at the end of the year 1867 to 5,017 kilometres, increased up to the end of 1870 to 10,798, and up to the end of 1877 to 20,467 kilometres. A further proof of this is afforded by the construction of a line from Nishnij-Nowgorod to

| Department. | Mining District. | Area. | | Output during 1875. | | | Means of Communicati'n. | | La |
|---|---|---|---|---|---|---|---|---|---|
| | | Square Kilometres. | Percentage of Forest land. | Coal. | Anthracite. | Lignite. | Railways, 1877. | Navigable Waterways. | A |
| | | | % | Met.Ton | Met.Ton | Met. T | Kilo-metrs. | Kilo-metrs. | Sq kil |
| Nowgorod, Pskow, Ssmolensk, Kaluga, Moscow, Twer | Moscow | 350 270·2 | 40·3 | 221,136 | .... | .. | .. | .. | |
| Rjasan | Moscow | 42,083·2 | 22 | 88,173 | .... | .. | .. | .. | |
| Tula | Moscow | 30,940·8 | 9 | 78,229 | .... | .. | .. | .. | |
| Great Russia .....Total | .... | .... | .. | 887,538 | .... | .. | 6,644 | 9,215 | 5,9 |
| Kijew | Kijew Jelisawetgrad | 50,974·1 | 25 | .... | .... | 17,906 | .. | .. | |
| Little Russia .....Total | .... | .... | .. | .... | .... | 17,906 | 1,571 | 2,140 | |
| Jekaterinosslaw | Donetz | 67,703·4 | 1 | 232,146 | 1,253 | .. | .. | .. | |
| Don Cossacks' district | Donetz | 160,397·0 | 2 | 188,963 | 420,196 | .. | .. | .. | |
| New Russia .....Total | .... | .... | .. | 421,109 | 421,449 | .. | 2,726 | 4,326 | 3,8 |
| Perm | Ural | 332,065·5 | 74 | 20,949 | .... | .. | .. | .. | |
| Czardom Kasan ....Total | .... | .... | .. | 20,949 | .... | .. | 1,084 | 5,071 | 1,8 |
| Piotrkow | Poland | 11,695·5 | .. | 391,278 | .... | 15,040 | .. | .. | |
| Kjelzy | Poland | 9,383·0 | 25·3 | 1,617 | .... | .. | .. | .. | |
| Kingdom of Poland ..Total | .... | .... | .. | 392,895 | .... | 15,040 | 891 | .. | |
| Kuban district | Caucasus | 23,437·5 | .. | 4,914 | .... | .. | .. | .. | |
| Daghestan district | Caucasus | 28,590·4 | .. | .... | .... | 546 | .. | .. | |
| Kutais Government | Caucasus | 20,820·4 | .. | 717 | .... | .. | .. | | |
| Caucasus .....Total | .... | .... | .. | 5,631 | .... | 546 | 1,105 | .. | 4,2 |
| Tomsk Government | Kusnetsk | 863,847·0 | .. | 4,201 | .... | .. | .. | .. | |
| Siberia .....Total | .... | .... | .. | 4,201 | .... | .. | .. | .. | 36,0 |
| Akmolinsk Territory | KirghiseDes'rt | 632,659·0 | .. | 13,118 | .... | .. | .. | .. | |
| Semipalatinsk „ | KirghiseDes'rt | 357,904·0 | .. | 518 | .... | .. | .. | .. | |
| Kuldsha „ | Turkestan | 71,225·0 | .. | 4,914 | .... | .. | .. | .. | |
| Sir-Darja | Turkestan | 512,330·0 | .. | 1,507 | .... | 377 | .. | .. | |
| Russian Central Asia..Total | .... | .... | .. | 20,057 | .... | 377 | .. | .. | 25,0 |
| Island of Saghalien (America) | Saghalien | 79·875·0 | .. | 1,571 | .... | .. | .. | .. | |
| Total .. | .... | .... | .. | 1,253,951 | 421,449 | 33,869 | .. | .. | |

Jekaterinburg (to be completed in the year 1878), with the intention of competi in the greatly increasing Asiatic trade with the new lines of steamers betwe Asia and Europe, by opening a new way to the Siberian traffic.

A new railway connection of the coal mining districts with the Baltic por would certainly tend to increase the demand for coal, but as there can be question of an *export* of Russian coal, a serious competition among the differe mining districts is not to be expected. All this tends, of course, to promote t *import* of coal into Russia.

The extent of the import, as well as that of the home production and expor is shown by the following table :—

| Year. | Production of Coal and Anthracite. | Production of Lignite. | Coal. Import. | Coal. Export. |
|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. |
| 1840 | 15,000 | ... | ... | ... |
| 1850 | 52,000 | ... | ... | ... |
| 1860 | 131,200 | ... | 968,911 | ... |
| 1866 | 271,537 | ... | 661,394 | ... |
| 1867 | 433,709 | 3,607 | 816,683 | .. |
| 1868 | 450,789 | 3,246 | 586,950 | .. |
| 1869 | 588,565 | 13,048 | 816,549 | ... |
| 1870 | 683,260 | 9,028 | 859,499 | ... |
| 1871 | 806,551 | 23,851 | 1,259,179 | ... |
| 1872 | 1,071,125 | 27,608 | 1,079,710 | ... |
| 1873 | 1,129,943 | 41,964 | 791,320 | ... |
| 1874 | 1,330,516 | 39,594 | 1,058,628 | ... |
| 1875 | 1,675,400 | 33,869 | 1,054,727 | 1,139 |
| 1876 | ? | ? | 1,497,214 | ... |

Coal is imported into Russia from *England*, *Germany*, and *Austria*. According to the official returns of these countries their export of coal to Russia, compared with the figures of the Russian returns, amounted to :—

| | Production. | Export. | Import. | Import from England. | Import from Germany | Import from Austria. |
|---|---|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. |
| In 1875 | 1,709,269 | 1,139 | 1,054,727 | 899,044 | 387,895 | 16,873 |

According to this statement the yield of coal in Russia already exceeds the quantity imported, even if we take the latter in conformity with the foreign returns in preference to those of the Russian officials. But what signifies a consumption of 180 to 190 million pud (2·9 to 3·1 millions of metric tons) for the immense Russian Empire? The *demand* for industrial purposes is indeed comparatively insignificant in Russia, and, as a matter of course, this feeble inquiry exerts its influence on the *market price*.

According to official returns the average price per pud in 1875 was for *anthracite:* Round coal, from 7·5 to 12 kopeks (from 1s. 6d. to 2s. 5d. per metric cwt.); nuts, from 7 to 9 kopeks (1s. 5d. to 1s. 9d. per metric cwt.), both at the pit's mouth; at Nowotscherkask, from 10 to 25 kopeks (2s. to 4s. 11d. per metric cwt.); at Rostow, from 15 to 30 kopeks (3s. to 5s. 11d. per metric cwt.); and at Taganrog, from 20 to 60 kopeks (3s. 11d. to 11s. 10d. per metric cwt.). For *coal* at the pit's mouth: Round coal, from 8 to 10 kopeks (1s. 7d. to 2s. per metric cwt.); nuts, from 6·5 to 8 kopeks (1s. 3d. to 1s. 7d. per metric cwt.). In *Poland* the prices are much lower, being from 4·5 to 7 kopeks per pud (from 11d. to 1s. 5d. per metric cwt.) for round coal; from 3·75 to 4·25 kopeks (9d. to 10d. per metric cwt.) for nuts; and from 0·33 to 2 kopeks (1d. to 5d. per metric cwt.) for slack. The average price of lignite is quoted at 2·25 kopeks per pud (5·4d. per metric cwt.).

These prices are moderate compared to those of other countries, and a considerable rise—as experienced, for example, in the seaport towns during the Russo-Turkish war—is an exceptional instance, which cannot be taken into account in making a general estimate.

Eight coal seams of considerable magnitude have lately been discovered in the Turkestan territory, extending in the Ili valley to a length of 42 kilometres, and in the Kash valley to a length of 10 kilometres. They are expected to be of material influence on the price of coal as well as on the import of foreign coal into Russia as soon as they will have become an object of mining enterprise.

## IRON.

Russia is comparatively rich in *iron ores*, but neither the forests nor the coal deposits of the country are sufficient to permit them to be worked in an adequate manner. There are ore beds in almost all departments, as will appear from our tabular statement on page 134. But the extent of the coalfields falls far short of that of the ores, a circumstance which renders a production of iron at a rate corresponding to the wants of the country very difficult, if not impossible.

The *Ural mountains* are the chief treasury of this subterranean wealth, with regard to the quantity as well as to the quality of the ores. The quantities of *magnetic ore* contained within them are very considerable; but by far the greater portion of the iron turned out by the Ural works is made from *brown ores*. Of *red ores* only very insignificant quantities have as yet been found in a deposit of limited extent in the western portion of the central Ural. Notwithstanding this abundance the iron industry in and near the Ural is not developed to such an extent as might be expected. Besides the rich deposits of magnetic, brown, and red ores, *chromic ore* is also found in the Ural, where it occurs generally in agglomerations and veins, and more especially in the serpentine strata not far from the central line of the mountain range. The output of this valuable ore, however, has greatly declined, being only 209,848 pud (3,437 metric tons) in 1875, against 450,973 pud (7,387 metric tons) in 1871.

The *Donetz mountains* contain ore deposits second only in extent to those of the Ural, but of a particular importance to the Russian iron industry, in consequence of the favourable proximity of the coalfields. *Brown ore* and *clay-ironstone* are the principal descriptions found here, their deposits being interposed between the strata of slaty sandstone (psammite), and of the slates of the carboniferous limestone.

The two private mining districts of *Moscow* include the Departments of *Wladimir, Nishnij-Nowgorod, Moscow, Tambow, Kostroma, Kaluga, Rjasan, Tula, Orel*, and *Pensa*. Here clay ironstone, brown and bog ore is found everywhere.

In the western Departments of *Wilna, Mohilew, Minsk*, and *Volhynia* bog ore is very extensively found.

In the *Olonetz* Department bog and lake ore is found, as well as brown ore and clay ironstone, ochre, and ferrugineous sandstone. Specular ore is found in the Powenetz district, copperas in the neighbourhood of the Kontshoferski iron-works, and magnetic ore in the Pudosh district.

*Finland* is well provided with magnetic, lake, and bog ore.

In the *Caucasus* rich ore beds are not wanting, and *Asiatic Russia* has her famous ancient mines in the *Altai Mountains*, in the *Nertshinsk* mining district of the *Jenisseisk* and *Jrkutsk* Departments.

The total output of iron ores was as follows:—

| | | | | | |
|---|---|---|---|---|---|
| In 1866..... | 581,771 | metric tons. | In 1871..... | 831,535 | metric tons. |
| „ 1867..... | 538,282 | „ | „ 1872..... | 893,614 | „ |
| „ 1868..... | 662,131 | „ | „ 1873..... | 908,507 | „ |
| „ 1869..... | 696,400 | „ | „ 1874..... | 934,783 | „ |
| „ 1870..... | 799,396 | „ | „ 1875..... | 1,063,831 | „ |

Notwithstanding the abundance of iron ores, the iron industry of the Russian Empire, compared with those of other civilised countries well provided with iron, is only inconsiderable. The fact ought not to be overlooked, however, that the Russian iron industry has advanced steadily, and that her production has increased in consequence of inherent vitality as well as of well-intentioned and effective subvention on the part of the Russian Government, and this even in the time subsequent to 1872 and 1873, when all other countries experienced a decrease in their production of iron. Some other extraordinary causes, as, for instance, the anticipation of large orders for military, railway, and navy purposes, may have been accessory to this result, yet the fact loses nothing of its significance.

The entire production of Russian iron was as follows:—

| Production in metric tons. | 1830. | 1840. | 1850. | 1860. | 1866. |
|---|---|---|---|---|---|
| Pig-iron | 183,104 | 180,639 | 227,743 | 297,937 | 314,850 |
| Wrought-iron | ... | ... | ... | 183,735 | 205,595 |
| | 1867. | 1868. | 1869. | 1870. | 1871. |
| Pig-iron | 323,121 | 324,711 | 332,850 | 359,989 | 359,272 |
| Wrought-iron | 225,945 | 231,015 | 248,548 | 251,582 | 254,002 |
| | 1872. | 1873. | 1874. | 1875. | |
| Pig-iron | 399,273 | 384,356 | 380,236 | 426,896 | ... |
| Wrought-iron | 268,123 | 255,296 | 294,441 | 303,819 | ... |

According to the works and districts the production is contributed as follows:

| Production in metric tons. | 1871. | | 1872. | | 1873. | | 1874. | | 1875. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pig-iron. | Wrought-iron. | Pig-iron. | Wrought-iron. | Pig-iron. | Wrought-iron. | Pig-iron. | Wrought-iron. | Pig-iron. | Wrought-iron. |
| Crown works | 37,192 | 11,874 | 30,253 | 11,848 | 37,869 | 10,957 | 36,582 | 11,282 | 40,422 | 12,751 |
| Besides in Poland | 3,349 | 2,146 | 4,661 | 1,404 | 4,830 | 1,634 | 4,290 | 1,157 | 5,197 | 1,552 |
| Imperial works | 1,011 | 300 | 1,505 | 477 | 1,338 | 385 | 1,209 | 645 | 1,755 | 576 |
| Private works: Ural | 211,584 | 135,252 | 243,962 | 152,135 | 202,767 | 147,319 | 210,647 | 160,268 | 252,101 | 170,421 |
| Moscow | 51,845 | 28,778 | 57,396 | 30,070 | 60,192 | 30,640 | 57,574 | 24,891 | 59,508 | 26,147 |
| Caucasus | 311 | 20 | .. | 14 | .. | .. | 287 | .. | .. | .. |
| Western & Southern Russia | 5,833 | 47,127 | 8,413 | 44,272 | 10,346 | 35,204 | 15,401 | 66,422 | 15,437 | 57,017 |
| Siberia | 5,002 | 2,298 | 2,471 | 2,136 | 3,803 | 2,321 | 2,627 | 2,153 | 6,495 | 2,442 |
| Kingdom of Polond | 23,157 | 13,750 | 22,969 | 13,405 | 26,709 | 15,561 | 26,345 | 17,070 | 26,378 | 17,970 |
| Olonetz | .. | .. | .. | .. | .. | .. | 91 | .. | .. | .. |
| Finland | 20,151 | 10,819 | 18,476 | 12,362 | 23,398 | 11,274 | 23,217 | 15,374 | 19,508 | 14,943 |
| Russia entire | 359,272 | 254,002 | 399,273 | 268,123 | 384,356 | 255,296 | 380,236 | 294,441 | 426,896 | 303,819 |

Accordingly the production of Russian iron considerably increased, even in the year 1875, at the very time when Great Britain, Germany, Belgium, Austria, the United States—in short, the most important iron-producing countries of the world—exhibit a reduction in almost every department of the iron industry.

Most prominent is the increase in the production of Russian *steel*, whereas the increase in her foundry products—which is known to consist for the greatest part of military articles and war material (ordnance, shot, plates for shipbuilding, armour, &c.)—is of less importance. This will appear from the following table of the entire Russian production of steel and castings:—

| | Steel. Metric Tons. | Castings. Metric Tons. | | Steel. Metric Tons. | Castings. Metric Tons. |
|---|---|---|---|---|---|
| 1860 | 1,051 | ... | 1871 | 7,244 | 31,665 |
| 1866 | 3,932 | ... | 1872 | 8,382 | 33,356 |
| 1867 | 6,271 | ... | 1873 | 8,944 | 56,530 |
| 1868 | 9,327 | ... | 1874 | 7,694 | 43,016 |
| 1869 | 7,200 | ... | 1875 | 12,928 | 57,164 |
| 1870 | 8,788 | ... | | | |

Evidently the Russian iron industry has suffered less from the crisis of late years than those of the other iron-producing countries. The chief cause of this is beyond all doubt the favourable proportion of the demand for iron to the production, the former being still in considerable excess of the latter.

The state of the entire production of iron during 1875 will appear from the following tables:—

| | Area. | | Production o | |
|---|---|---|---|---|
| | Square Kilometres. | Of which are Forests. | Output of Iron Ores. | Blas<br>Quantity of Ore melted. |
| | | Per cent. | Metric | |
| St. Petersburg | 44,198·0 | .. | .. | .. |
| Baltic Provinces—Total | .. | .. | .. | .. |
| Abo-Björneborg | 25,627·9 | .. | .. | 7,403 |
| Tawastehus | 17,967·1 | .. | .. | .. |
| Nyland | 11,531·9 | .. | .. | 7,662 |
| Wiborg | 34,777·1 | .. | 7,940 | 8,216 |
| St. Michel | 23,023·7 | .. | 74,737 | 6,824 |
| Knopio | 42,569·6 | .. | .. | 20,034 |
| Wasa | 40,229·7 | .. | .. | .. |
| Uleaborg | 153,466·2 | .. | .. | 7,680 |
| Great Duchy of Finland—Total | .. | 52·3 | 82,677 | 57,819 |
| Wologda | 401,502·0 | 87 | 798 | 809 |
| Olonetz | 130,871·3 | 80 | 2,508 | 4,833 |
| Northern Provinces—Total | .. | .. | 3,306 | 5,642 |
| Nowgorod | 119,942·8 | 63 | .. | .. |
| Kaluga | 30,759·2 | 25 | 44,643 | 47,505 |
| Wladimir | 48,706·8 | 47 | 15,242 | 11,589 |
| Nischnij-Nowgorod | 50,841·3 | 50 | 95,400 | 50,261 |
| Tambow | 66,078·0 | 18 | 21,062 | 8,787 |
| Rjasan | 42,083·2 | 22 | 12,286 | 7,087 |
| Tula | 30,940·8 | 9 | 3,895 | 4,077 |
| Orel | 46,705·3 | 23 | 5,474 | 2,904 |
| Great Russia—Total | .. | .. | 198,002 | 132,201 |
| Wilna | 42,491·4 | 30 | 13,206 | 13,266 |
| Volhynia | 71,801·7 | 42 | 5,034 | 4,338 |
| Western or White Russia—Total | .. | .. | 18,300 | 17,604 |
| Jekaterinosslaw | 67,703·4 | 1 | 14,418 | 14,233 |
| Don Cossack's District | 160,397·0 | 2 | 3,391 | 3,276 |
| New Russia—Total | .. | .. | 18,209 | 17,509 |
| Pensa | 38,938·4 | 35 | 698 | 1,384 |
| Wjatka | 153,251·2 | 68 | 68,998 | 54,653 |
| Perm | 332,065·2 | 74 | 431,778 | 423,077 |
| Czardom Kasan—Total | .. | .. | 501,474 | 479,114 |
| Orenburg | 191,613·3 | 29 | 23,343 | 23,723 |
| Ufa | 121,770·6 | 53 | 73,652 | 60,619 |
| Czardom Astrachan—Total | .. | .. | 96,995 | 84,342 |
| Piotrkow | 11,695·5 | .. | 33,299 | 15,270 |
| Radom | 12,323·5 | 31·8 | 92,187 | 81,468 |
| Kjelzy | 9,383·0 | 25·3 | 7,827 | 10,944 |
| Lublin | 16,222·0 | 25 | .. | .. |
| Sjedletz | 13,722·2 | .. | .. | .. |
| Plozk | 10,352·8 | 19 | .. | .. |
| Kingdom of Poland—Total | .. | .. | 133,313 | 107,705 |
| Tomsk Government | 863,847 | .. | 1,065 | 1,226 |
| Jenisseisk Government | 2,516,833 | .. | 3,477 | 3,477 |
| Irkutsk | 704,064 | .. | 4,732 | 4,733 |
| Transbaikalian country | 553,778 | .. | 2,281 | 2,803 |
| Siberia, Total | .. | .. | 11,555 | 12,239 |
| Total | .. | .. | 1,063,831 | 913,607 |

| ı during 1875. | | | | | Means of Communication. | | |
|---|---|---|---|---|---|---|---|
| ıces. | | | | | | | |
| Production of | | Bar Iron, Rails, &c. | Plates and Sheets. | Steel. | Railways, 1877. | Navigable Waterways. | Lakes. |
| ron. | Castings. | | | | | | |
| s. | | | | | Kilometres. | | Square Kilos |
| | .. | 21,309 | 2,029 | 4,351 | .. | .. | .. |
| | .. | 21,309 | 2,029 | 4,351 | 1,472 | 1,323 | 11,469·1 |
| 331 | .. | 5,182 | .. | .. | .. | .. | .. |
| | .. | 567 | .. | .. | .. | .. | .. |
| 777 | .. | 2,546 | .. | .. | .. | .. | .. |
| 210 | 225 | .. | .. | .. | .. | .. | .. |
| 967 | .. | 988 | .. | .. | .. | .. | .. |
| 326 | 22 | 3,817 | 150 | .. | .. | .. | .. |
| | .. | 146 | .. | .. | .. | .. | .. |
| 454 | .. | 1,547 | .. | .. | .. | .. | .. |
| 565 | 247 | 14,793 | 150 | .... | 848 | .. | 41,670·8 |
| 178 | 42 | 208 | .. | .. | .. | .. | .. |
| 459 | 1 | 5 | .. | .. | .. | .. | .. |
| 537 | 43 | 213 | .. | .. | 107 | 5,299 | 36,331·8 |
| | .. | 3 | .. | .. | .. | .. | .. |
| 235 | 11,050 | 4,293 | .. | .. | .. | .. | .. |
| 563 | 259 | 3,132 | 436 | .. | .. | .. | .. |
| 364 | 992 | 15,881 | 227 | 2,985 | .. | .. | .. |
| 971 | 126 | 1,135 | .. | .. | .. | .. | .. |
| 593 | 1,312 | 2,454 | .. | .. | .. | .. | .. |
| 996 | 936 | .. | .. | .. | .. | .. | .. |
| 328 | 764 | 12,679 | .. | .. | .. | .. | .. |
| 350 | 15,439 | 39,577 | 663 | 2,985 | 6,644 | 9,215 | 5,982·8 |
| 331 | 73 | 2,359 | .. | .. | .. | .. | .. |
| 237 | 323 | 248 | .. | .. | .. | .. | .. |
| 868 | 396 | 2,607 | .. | .. | 3,145 | 6,536 | 2,744·4 |
| 781 | 24 | 12,508 | .. | .. | .. | .. | .. |
| 392 | .. | 3,849 | .. | .. | .. | .. | .. |
| 173 | 24 | 16,357 | .. | .. | 2,726 | 4,326 | 3,862·3 |
| 385 | 34 | .. | .. | .. | .. | .. | .. |
| 356 | 2,392 | 11,605 | 3,126 | 88 | .. | .. | .. |
| 527 | 25,320 | 88,790 | 52,697 | 2,843 | .. | .. | .. |
| 268 | 27,746 | 100,395 | 55,823 | 2,931 | 1,084 | 5,071 | 1,873·5 |
| 064 | 1,732 | 12,679 | .. | .. | .. | .. | .. |
| 327 | 4,833 | 17,278 | 537 | 2,163 | .. | .. | .. |
| 391 | 6,565 | 29,957 | 537 | 2,163 | 889 | 4,914 | 18,901·2 |
| 468 | 2,921 | 1,003 | 28 | .. | .. | .. | .. |
| 168 | 1,756 | 12,031 | 383 | .. | .. | .. | .. |
| 386 | 811 | 1,627 | 1,731 | .. | .. | .. | .. |
| . | .. | 4,178 | .. | .. | .. | .. | .. |
| . | .. | 2,957 | .. | .. | .. | .. | .. |
| . | .. | 41 | .. | .. | .. | .. | .. |
| 022 | 5,488 | 21,837 | 2,142 | .. | 801 | .. | .. |
| 491 | 27 | 218 | .. | .. | .. | .. | .. |
| 042 | 547 | 1,273 | 121 | .. | .. | .. | .. |
| 606 | 300 | 947 | 101 | 8 | .. | .. | .. |
| 871 | 201 | 351 | 7 | 12 | .. | .. | .. |
| 010 | 1,075 | 2,789 | 229 | 20 | .. | .. | 36,052 |
| 732 | 57,164 | 243,126 | 60,693 | 12,923 | .. | .. | .. |

The Russian ores, as well as the different descriptions of iron made from them, are of the very best *quality*. The ores are rich in iron and the greatest part of them also contain a comparatively large admixture of manganese. The weight of the pig-iron produced varies from 29 to 56 per cent of the weight of the ores.

However high the legitimate price may be, which Russian iron is worth in consequence of its quality, yet the undue increase of price effected by the prohibitive tariff of the Empire must of necessity prove injurious to the demand for iron, and consequently to the production of iron itself. If we consider this matter from a national-economic point of view, we may safely assert that no people in the world are paying as much for their iron as the Russians. Thus as late as 1875 the following prices per pud (=16·38 Kilo.) were quoted in the kingdom of *Poland:* Pig-iron 60 Kop. (1s. 11d.); cast or scrap iron, 1 Rub. 20 Kop. (3s. 11d.); bar iron from 1 Rub. 50 Kop. (4s. 10d.) to 2 Rub. (6s. 6d.); sheets, 2 Rub. 25 Kop. (7s. 4d.); these prices being just twice as high as those paid in Germany or England. In the interior of the country the prices are much higher still; in *Tula*, for example, the following were average prices per pud in 1875: Pig-iron from 1 Rub. 85 Kop. (6s.) to 2 Rub. 10 Kop. (6s. 10d.); castings from 2 Rub. 20 Kop. (7s. 2d.) to 3 Rub. 20 Kop. (10s. 5d.); sheets from 4 Rub. 30 Kop. (14s.) to 4 Rub. 60 Kop. (14s. 11d.); bar, hoop, angle, round, and sectional iron from 2 Rub. 25 Kop. (7s. 4d.) to 2 Rub. 50 Kop. (8s. 1d.); English steel from 9 Rub. 40 Kop. (£1 10s. 5d.) to 10 Rub. 20 Kop. (£1 13s.) The following were wholesale prices per pud:—At *St. Petersburg*, Russian iron from 1 Rub. 70 Kop. (5s. 6d.) to 3 Rub. (9s. 9d.); foreign iron from 1 Rub. 75 Kop. (5s. 8d.) to 2 Rub. 10 Kop. (6s. 10d.) At *Taganrog*, Russian iron from 1 Rub. 90 Kop. (6s. 2d.) to 2 Rub. 40 Kop. (7s. 10d.) At *Riga*, steel from 3 to 10 Rub. (from 9s. 9d. to £1 12s. 6d.) At *Odessa*, steel from 1 Rub. 70 Kop. (5s. 6d.) to 2 Rub. 85 Kop. (9s. 3d.)

The high prices of iron and steel are also evident from the official average valuations, according to which the Russian custom-house officials are instructed to levy the import duties, and which are published in the official trade statistics.

These high quotations would certainly be productive of a very lively home and foreign trade in iron and steel, if the population of Russia was only possessed of sufficient wealth to be a large consumer. But in consequence of the defficiency of national prosperity, as well as of the manifold obstructions to commercial intercourse, and of the expensive transport, only a very insignificant traffic in iron, steel, and hardware exists in Russia. A single glance at the map will suffice to convince us that Russia is still very deficient in means of conveyance and communication, however large the mileage of her railways and navigable waterways may at first sight appear. This fact is likewise fully borne out by the statistical returns of the inland and foreign traffic. A lively wholesale trade is only carried on between a few *centres*, and the commercial intercourse of the enormous number of small country places consists merely of an insignificant retail trade.

The Tabular Statement, page 137, of the production and of the export during 1875, shows that Russia occupies in fact one of the lowest places in the scale of the civilised nations of Europe if judged according to the amount of circulation and consumption of iron and steel.

The value of the import of machinery has only been determined by estimate, a large portion of this machinery not being entirely made from iron and steel. Supposing the value of the ironwork contained in the imported machinery to be 20 Roubles per pud (£19 15s. 7d. per metric ton)—and in doing so we may be sure not to arrive at too low a computation—the quantity of iron and steel imported in the shape of machinery may be said to be 1,728,533 pud or 28,314 metric tons. The entire quantity of iron and steel imported into Russia would accordingly amount to 24,275,618 pud, or 397,645 metric

tons. This import, compared with that of other countries, seems to be very large: it is only inferior to the German and Dutch imports. But even if we add to it the home production of iron and steel of Russia, at the rate of 400,000 metric tons, we would arrive at a total consumption of 800,000 metric tons by 86,000,000 inhabitants of European and Asiatic Russia, this being a rate of not quite 10 kilos per head!

| | Import. | Export. | From and to Asia. | |
|---|---|---|---|---|
| | | | Import. | Export. |
| Pig Iron, metric tons | 57,464 | ... | ... | ... |
| Bar Iron „ | 87,705 | 1,178 | 144 | 1,953 |
| Iron Rails „ | 58,126 | ... | 22 | ... |
| Steel Rails „ | 111,554 | ... | ... | ... |
| Hoops, Sheets, &c., metric tons | 31,031 | 2,944 | 38 | Cont. in bar iron. |
| Plates, metric tons | 3,813 | ... | 3 | 1 |
| Steel „ | 19,638 | ... | 62 | 265 |
| Machinery of all kinds, value £ sterling | 5,600,449 | 9,371 | 25,119 | ... |

# SWEDEN.*

## 499,763 SQUARE KILOMETRES. 4,383,291 INHABITANTS.

As in all other countries, so in *Sweden*, two agencies have mainly exerted their influence upon the development of its mining and smelting industries—mining legislation and the system of general intercommunication. Natural conditions, such as the extent and productiveness of the forests and the means of supplying some substitute for coal and iron, have only had a secondary influence.

In Sweden mining and smelting have lagged behind, because proprietors have not been supported by mining legislation in their just and economically well founded claims, and because they are not benefited by a regular system of means of communication established and maintained by the State.

The mining law of the 12th of January, 1855,† is still in force in Sweden, and with it the overwhelming privileges of the *landowner* as opposed to those of the *miner*.

According to paragraph 1 of the Act, the objects to be claimed for mining are:—

(1) All metals and *ores* in *mountains* or in the earth or at the bottom of *lakes*, *swamps*, and *ditches*. (2) Pyrites, black lead, and *pit coal*. (3) Spoilbanks of abandoned pits which contain the minerals enumerated under (1) and (2). Abandoned pits can be re-leased for the above minerals.

This arrangement proves that Sweden in her mining operations is looking more to her *ores* than to her *coal*, and that even ore mining is not carried on under the same geological conditions as in other countries where only solid strata are penetrated. In Sweden ores are recovered also from the bottom of lakes,

* Contributed by Dr. A. Frantz, of Beuthen.

† *See* Zeitschrift für Bergrecht, herausgegeben vom Berghauptmann Dr. Brassert. V. Jahrgang, 1864, p. 293. Bonn, Ad. Marcus.

ditches, and swamps—a fact due to the *peculiar geological* formation of that country. Here the "lake and bog ores" are nearly of the same quality as those in other countries of more solid formation, as, for instance, in Upper Silesia. Swedish coal is nearly all of a more recent formation than that of other countries, and for that reason it will never occupy a very prominent position as fuel or for admixture in the home production of Swedish iron.

Sweden like other countries ought to open her doors to *foreign capital* for the development of her mining industries. Instead of that, however, the Mining Act of 1855 restricts this desirable support for Sweden, and the supplementary royal decree of April, 1872, imposes still greater difficulties upon foreigners intending to purchase and to work mining property in Sweden. These *restrictions* on the investment of capital, which would be of great benefit to the mining trade and to the country at large, argue but little for Sweden's political and economical wisdom.

Under such mining laws, completed by a rigid control of trade marks, mining and smelting can all the less be expected to rise according to the metalliferous wealth of the country, inasmuch as ready and serviceable means of communication, such as are offered by the *railways* in other civilised countries of Europe, are wanting in Sweden.

Although the *association of capital* has lately wrought many improvements, and has been of special assistance in consolidating and combining small concerns, two powerful agencies still exercise their dominating influence : the *want of means of communication and capital*, and the *abundance of forests;* the latter goes hand in hand with the former, as it is just the forests which often constitute impediments to the construction of new railways. Besides, the influence of the winter, with its natural sledge roads, intensifies the dislike to construct and maintain comparatively expensive though much more useful railways.

The discovery and extension of coalfields, an increased activity in working them, and the import of foreign coal will hardly improve the conditions which thus exist as a matter of fact, and even the completion of a more perfect railway system will not effect any material alteration. Even when through further extension of the railways smelting operations will not be tied to the spot where forests and ironstone occur, when their extent will be no longer dependent on the proximity and the quantity in store of both these materials, when conveyance and export may be facilitated and cheapened by railways and canals, and when consolidation, and with it enlargement and strengthening of capital, will increase the extent and technical perfection of the works, even then the peculiar circumstances of Sweden do not lead us to expect a great development of the Swedish iron trade such as has been possible in Great Britain, Belgium, Germany and France, and even in Russia. The remarks which we shall have to make further on will prove this proposition.

## COAL.

The comparatively great abundance of forests, which occupy about 42% of the total area of Sweden, seems to have been given by Nature as a substitute for the immense underground forests, the coalfields, possessed by other countries competing with Sweden in the iron trade.

In the north-western part of the province of Skäne several beds of clay and sandstone are found, which are supposed to belong to the upper part of the *Trias* and the lower part of the *Jurassic* formation. In these beds the only *coal seams* which Sweden possesses have been found. They are being worked at Zöganäs, Lillespon, Helsingborg, and other places, and at one time great speculations were founded upon them.

It can be assumed with some certainty that further discoveries will not be made. The coal beds of the Jurassic formation cropping up at the surface in

Skäne have been covered by about 9,000 concessions (mut redlor), and are extending over 914 square kilometres. The thickness is 1·8 metres on the average. More recent borings prove the existence of coal to an extent of about 1,600 square kilometres.

In the official return Swedish coal is classed in three qualities. According to the investigations made in E. ERDMANN'S geological bureau some samples of the different descriptions contained :—

| | Gases. | Carbon. | Ashes. |
|---|---|---|---|
| First Class | 32·9 | 64·1 | 3·0% |
| Second Class | 25·0 | 54·7 | 20·3% |
| Third Class | 17·4 | 39·3 | 43·3% |

The inferiority of Swedish coal as compared to the coal of other countries is here at once apparent, and it is scarcely desirable that the output of Swedish coal, so far as second and third rate sorts are concerned, should be extended. Only a small portion of the coal is fit for *coking*, and even that in but minor degrees. The use of Swedish coal for *making gas* is, with few exceptions, entirely out of the question, and thus it is settled that Sweden's collieries can never supply anything but an inferior and makeshift material.

Whether and how far the several coalfields, according to the peculiar circumstances of the country, are capable of yielding a greater output, may be concluded from the following table :—

| Total Output. | 1863. | 1873. | 1874. | 1875. |
|---|---|---|---|---|
| | Cubic Feet.* | Cubic Feet.* | Cubic Feet.* | Cubic Feet.* |
| Höganäs—1st class | 427,644 | 516,192 | 434,342 | 435,304 |
| Do. 2nd class | 677,490 | 893,629 | 727,422 | 882,552 |
| Do. 3rd class | 345,150 | 437,863 | 337,659 | 332,715 |
| Wallåkra Co.—1st class | .... | 219,372 | 615,468 | 844,603 |
| Do. 2nd class | .... | 177,912 | | |
| Boserups Concession (since 1866)—1st class | .... | 50,000 | 74,261 | 76,000 |
| Do. do. 2nd class | .... | 8,000 | 12,779 | 13,500 |
| Kropps Co. (since 1873) | .... | 48,398 | 476,449 | 427,785 |
| Eslöf Co. (since 1873) | .... | 22,320 | 40,730 | 47,406 |
| Helsingborg Coal Co. (since 1866) | .... | 32,800 | 10,500 | 7,1±3 |
| Total | 1,450,284 | 2,406,486 | 2,729,610 | 3,066,981 |
| Or Metric Tons | 36,257 | 60,162 | 68,240 | 76,674 |

In 1876 the output was 3,694,074 cubic feet, or 92,352 metric tons. The official publication relating to it has not yet made its appearance.

The coal is used in the smelting works belonging to the colliery owners, or for other purposes, in the immediate neighbourhood of the coalpits. It is of but little account in the requirements in the country, which are chiefly supplied by importation. The *price* of coal per metric ton in 1863 was, according to the official record of the Stockholm Exchange, as follows :—

| | s. | d. | | s. | d. | | s. | d. |
|---|---|---|---|---|---|---|---|---|
| 1863 | 20 | 0 | 1868 | 16 | 4 | 1872 | 27 | 2 |
| 1864 | 18 | 2 | 1869 | 15 | 11 | 1873 | 25 | 11 |
| 1865 | 17 | 3 | 1870 | 13 | 7 | 1874 | 20 | 5 |
| 1866 | 18 | 2 | 1871 | 13 | 7 | 1875 | 19 | 6 |
| 1867 | 18 | 2 | | | | | | |

It is evident from this that the coal prices in Sweden followed the fluctuation of the general coal market, and the remarkable rise from 1871 to 1872 is especially noteworthy. Even at present, prices are higher than before 1872.

* Cubic feet of 25 kilos. = 55·1lb. avoirdupois weight.

The importation of foreign coal is continually on the increase—a proof on the one hand that the insufficiency of the supply of wood becomes more and more apparent, on the other hand that the economical advantages of the use of mineral coal begin to be better felt and understood.

Here we shall only briefly state that the quantity of imported coal and coke amounted to :—

| During the year | 1855. | 1864. | 1873. | 1874. | 1875. | 1876. |
|---|---|---|---|---|---|---|
| Metric Tons | 135,652 | 412,845 | 681,202 | 731,687 | 896,174 | 946,092 |

Excepting 200,000 or 300,000 cubic feet (5,000 to 7,500 metric tons) the whole of the import comes from England. The small balance even is probably of English origin, for it comes from Denmark, Schleswig-Holstein, Prussia, &c.

In order to indicate at least the consuming districts it is perhaps sufficient to refer to the following distribution of the total import of 35,846,982 cubic feet (896,174 metric tons) amongst the various ports. According to "Sveriges officiela Statistik F. Utrikes Handel och Sjöfart for ar 1875" this distribution has been as follows :—

| | Metric Tons. | | Metric Tons. | | Metric Tons. |
|---|---|---|---|---|---|
| Haparanda | — | Söderköping | 579 | Landskrona | 31,698 |
| Kanea | — | Jönköping | — | Helsingborg | 25,037 |
| Pitea | 266 | Westervik | 21,807 | Halmstad | 4,635 |
| Umea | — | Oskarshamn | 8,477 | Falkenberg | 548 |
| Hernösand | 3,995 | Calmar | 3,977 | Warberg | 560 |
| Sundsvall | 8,368 | Wisby | 5,240 | Göteborg | 264,319 |
| Hudiksvall | 1,744 | Carlskrona | 15,754 | Kongelf | 569 |
| Söderhamn | 1,790 | Carlshamn | 4,341 | Marstrand | 304 |
| Gefle | 47,010 | Sölvesborg | 1,398 | Uddevalla | 18,965 |
| Grisselhamn | 751 | Christianstad | 8,232 | Strömstad | 799 |
| Stockholm | 238,047 | Cimbrishamn | 2,668 | Carlstad | — |
| Nyköping | 2,291 | Ystad | 16,888 | Norwegian Frontier | 3,255 |
| Norrköping | 39,886 | Trelleborg | 12,652 | | |
| Linköping | — | Malmö | 99,324 | | |

From these seaports the coal, or as much as is not required for local purposes, is conveyed to the great industrial establishments in the immediate neighbourhood, where it is used for the supply of steam. The use of coal for domestic purposes is not of any appreciable extent, except in the larger seaport towns, as Stockholm, Göteborg, Malmö, and others.

## IRON.

With regard to her *iron ores* Sweden may be called the most favoured country of the world, on account of their quality as well as their variety. The ore beds mostly coincide with the forest districts, and are consequently of a comparatively great extent. Besides the enormous ore deposits near *Gellivara* and some other places far up in *Lapland*, the largest seams, as regards both extent and thickness, are situated within a tract of country running from east to west and extending from Uppland and the southern part of Gestrickland through Westmanland and Nerike and through southern Dalarne to the eastern part of Wermland. Apart from this district there are also iron ores in Södermanland and Oestergölland, but they are in less quantity and of inferior quality; also in Småland, on the southern end of the Wetter lake, where the Taberg consists of them. These are the principal beds of the "mountain ores." Other places abound in *lake* or *bog ores*, which however are only worked in Småland. The cubical contents of these deposits have nowhere been accurately ascertained. The different descriptions of ores are generally in conformity with the geological formation of Sweden.

The Swedish iron ores chiefly consist of *magnetic* (sesquioxide) and *specular ores* (oxide of iron), and are found in the metamorphic rocks as agglomerations in the gneiss and eurite (called "Hälleflinta" in Sweden), further in the mica-schists and the metamorphic limestone. The *lake* and *bog ores* of course are of a different formation and quality.

The magnetic ores of the *Svart mountain* contain the largest quantity of *manganese*—mostly from 15 to 20 per cent of the protoxide. They are worked for spiegeleisen at the Schisshütte furnaces in Kopparberg-Län. The magnetic ore of the Penning mines in Gefleborg-Län also contains from 12 to 14 per cent of manganese.

The Swedish mountain ores are especially distinguished by their comparative *freedom from phosphorus*, as they contain only from 0·05 per cent down to a minimum of 0·003 per cent of it. The lake and bog ores, however, frequently contain much phosphorus.

The sulphur is removed from the ores by careful calcination.*

The output of iron ores in Swedish cwt. (equal to 42·5 kilogrammes, or to 93·7lb. avoirdupois) amounted to :—

| | 1840. | 1850. | 1860. | 1866. | 1867. | 1868. | 1869. |
|---|---|---|---|---|---|---|---|
| Mountain Ores.. | 6,105,514 | 6,589,957 | 9,290,973 | 11,366,078 | 11,401,831 | 12,594,439 | 18,920,634 |
| Lake & Bog Ores | | | 522,643 | 191,910 | 408,436 | 294,175 | 147,215 |

| | 1870. | 1871. | 1872. | 1873. | 1874. | 1875. | 1876. |
|---|---|---|---|---|---|---|---|
| Mountain Ores.. | 14,508,278 | 15,215,589 | 16,938,345 | 19,458,339 | 21,692,998 | 18,996,654 | 18,528,505 |
| Lake & Bog Ores | 323,436 | 370,784 | 292,224 | 126,147 | 101,122 | 351,354 | 211,788 |

During the last forty or fifty years the use of blast-furnaces for making pig-iron has become general in Sweden, and the production of wrought-iron direct from the ores has been abandoned. According to the various descriptions of ores and of iron the fuel used is either charcoal alone or charcoal together with wood (oak), or with English coke ; or peat either alone or together with charcoal; the quantity of fuel also varies much. A metric ton of pig-iron requires from five to eight cubic metres of charcoal (on the average from 5·8 to 6·6 cubic metres), or by weight 100lb. of pig-iron require from 75lb. to 85lb. of charcoal. The charcoal is made almost exclusively from pine and firwood, 0·165 cubic metres of it containing only about 21·3 kilo. of carbon.

As a rule the mixed ores yield from 40 to 50 per cent of pig-iron, and for each cubic metre of charcoal there are charged from 260 to 450 kilo. of ore and limestone. The weekly produce of the smallest furnaces is from 31 to 65 metric tons, of the middle sized 65 to 68, and of the largest 86 to 132 metric tons of pig-iron.

The following table indicates the average returns of the Swedish furnaces during a year's working :—

| During the Year. | 1871. | 1872. | 1873. |
|---|---|---|---|
| Pressure of blast in millimetres of mercury | 44·7 | 49 | 33 |
| Temperature of blast (Centigrade) | 195 | 200 | 195 |
| Single charge of charcoal (hectolitres) | 12·27 | 12·17 | ? |
| Limestone flux, per cent | 11·8 | ? | ? |
| Hectolitres of charcoal, to make 50 kilos. of pig-iron.. | 3·20 | 3·50 | 3·623 |
| Yield of the ores, in percentage of their weight | 46·65 | 46·33 | 44·12 |

* A collection of analyses, with an accurate account of the various qualities of Swedish iron ore, is contained in the pamphlet, "On the State of the Manufacture of Iron in Sweden at the beginning of the year 1873," by RICHARD AKERMAN, assistant at the mining academy of Stockholm. This treatise was published at the expense of the "Iron Department" (Jerns contoret), and printed in the Swedish language by K. L. Beckman, at Stockholm, in the year 1873, subsequently it has been translated into several languages, especially German, French, and English, and can be obtained from the booksellers.

The production of the Swedish furnaces has been much reduced at times by the irregular supply of ores and fuel,* by the want of motive power, which is mostly derived from water, and for want of hands, in consequence of the latter leaving the furnaces in large numbers, especially during harvest and tilling time, in order to attend to their agricultural pursuits. Owing to these circumstances the working of the furnaces is very irregular as to time and production, which is made apparent by the following compilation, derived from the official mineral statistics :—

| During the Year. | Number of Furnaces. | | Number of Men. | Per Furnace. | | Production per Annum in Metric cwt.=100 kg. | |
|---|---|---|---|---|---|---|---|
| | Out of Blast. | In Blast. | | Working Days per Annum. | Daily Production in Metric cwt. =100 kg. | Per Furnace. | Per Man. |
| 1866..... | 80 | 220 | 3,565 | 150 | 69·6 | 10,455 | 645·1 |
| 1867..... | 81 | 220 | 3,586 | 158 | 73·0 | 11,521 | 706·3 |
| 1868..... | 94 | 207 | 3,616 | 165 | 77·1 | 12,710 | 727·6 |
| 1869..... | 102 | 199 | 3,590 | 188 | 78·1 | 14,681 | 813·7 |
| 1870..... | 88 | 213 | 3,815 | 178 | 79·2 | 14,102 | 787·3 |
| 1871..... | 92 | 207 | 3,812 | 181 | 79·7 | 14,437 | 783·9 |
| 1872..... | 95 | 212 | 4,090 | 197 | 81·2 | 16,012 | 829·9 |
| 1873..... | 100 | 213 | 4,206 | 202 | 80·2 | 16,195 | 820·1 |
| 1874..... | 104 | 217 | 4,458 | 180 | 83·9 | 15,108 | 735·4 |
| 1875..... | 101 | 224 | 4,854 | 184 | 85·3 | 15,697 | 724·3 |
| 1876..... | ? | 205 | 4,542 | 190 | 90·4 | 17,191 | 775·9 |

The number and production of the iron and steel works may be seen from our table on pages 144 and 145.

The greatest part of Swedish wrought-iron manufactured according to the old process is made in *Lancashire fires*. The particular qualities of Swedish pig-iron require, however, some special appliances and a particular process of manufacture. At larger works the balls are shingled by cast-iron helves of about 34 to 43 metric cwt., at smaller works by tilters of about 12 metric cwt., and here and there steam hammers of 6 to 8 metric cwt. are used.

Cogging mills are also found at several places. Where these appliances are not at hand the *Franche-Comte* process is also used, and in the *Danemora* district the *Walloon* process is of long standing.

Puddling is only resorted to by works which are making their own iron, especially at Motala, Surahammar, Guanebo, Kallinge, and Nyby. These works use English coal as fuel, wood being applied only at Surahammar and Nyby.

Especially important for Sweden is the manufacture of *Bessemer steel*.

In three of the oldest Bessemer works, where the production has never been large, there are still fixed converters ; all others have movable ones, and in all of them the pig is taken direct from the blast-furnace without remelting. The converters are charged with from 2,100 to 4,200 kilo. ; they have from 7 to 13 tuyères each, with from 7 to 13 openings of from 12 to 18 millimetres diameter. The pressure of the blast is generally kept at from 6 to 900 millimetres of mercury and a charge is usually finished in from 5 to 10 minutes. Sandviken excepted, where steam is partially used, all the larger works are driven by water-power. The blowing-engines have generally about 500 horse-power ; many of the latest have from 700 to 800 horse-power.

In the greater number of works from 1 to 2 per cent of spiegeleisen is added at the end of the process, but in the production of soft steel this has lately been to some extent superseded by ferromanganese, a compound which is richer in

* The snowfall and the sledge roads created by it continue to play the most important part in the supply of materials for the ironworks of Sweden.

manganese. Other works do not require spiegeleisen at all, because the use of ores rich in manganese enables a steel of any degree of softness to be produced without fear of red shortness.

In the production of soft iron from 80 to 85 per cent, and in that of steel from 85 to 90 per cent of the pig-iron is obtained in the form of ingots. The loss by combustion is between 9 and 15 per cent, that by scale and waste from 0 to 5 and 6 per cent.

Since 1868 cast-steel has been made at the Munkfors Works, which belong to the Uddeholms Company, in a Siemens' regenerative furnace, with a Lunden condenser, by the Martin process. Later on several other works have also adopted the same method, but chiefly for the manufacture of soft iron.

These furnaces are small, and will only hold from 850 to 3,400 kilo. As fuel, partly air-dried wood and partly machine peat is being used, the consumption of either being about the same, namely, from 5 to 7½ cubic metres per metric ton of ingot.

At Vikmanshytta cast-steel is made according to Uchatius' process, from granulated pig-iron mixed with powdered rich iron ore, and a little coal. This is melted in graphite crucibles, in the ordinary English melting-holes, fired with coke. Steel made in this way proves of special excellence for purposes which, besides considerable hardness, demand particular strength, such as hammers, &c.

There has always been produced a goodly quantity of German steel, which has come into the market in forged bars, and under different names. At some few works puddled steel is also made, and at Graninge a little German steel is still made in open fires. At Osterby crucible cast-steel is produced in Siemens-Lunden furnaces, with wood as fuel. The total production of iron and steel in Sweden may be seen from the table on pages 144 and 145, where it is divided according to the different provinces.

The following is the mileage of State and private railways in Swedish miles (equal to 10·69 kilometers) :—

| Provinces. | State Lines. | Private Lines. | Provinces. | State Lines. | Private Lines. |
|---|---|---|---|---|---|
| Wester-Norrland | .. | 5·3 | Westmanland.. | 4·9 | 20·3 |
| Gefleborg ..... | 5·2 | 10·1 | Oerebro ..... | 12·2 | 32·1 |
| Upsala ..... | .. | 15·8 | Skaraborg .... | 21·6 | 13·5 |
| Stockholm .... | 11·6 | 3·5 | Wermland .... | 14·0 | 16·5 |
| Kopparberg .... | 9·4 | 12·9 | Elfsborg ..... | 7·3 | 12·2 |
| Göteborg-Bohus | 0·8 | 0·9 | Kronoberg .... | 9·3 | 15·9 |
| Södermanland .. | 12·5 | 12·9 | Blekinge ..... | .. | 5·4 |
| Oestergölland .. | 11·8 | 7·1 | Malmöhus .... | 5·0 | 25·7 |
| Calmar ..... | .. | 10·5 | Christianstad.. | 5·5 | 9·8 |
| Jönköping .... | 16·2 | 13·9 | Entire Sweden | 147·3 | 244·3 |

According to this the State railways had a length of 1,574·43 kilometres, the private lines of 2,611·23 kilometres, the total mileage being 4,185·66 kilometres. Since November, 1876, there had been in course of construction, and partly open for traffic in 1877, 1,856 kilometres of private lines, of which 1,180 kilometres are of the normal gauge, and 676 kilometres are of narrow gauge. To this must be added the State line, Oekelbo-Torpshammer—Norway's border, with 532 kilometres, so that the railway system of Sweden will shortly have a total length of 6,574 kilometres.

The extent of the lines in connection with pits and ironworks is not accurately known, but, with the many additions since 1871, it may have risen to 100 kilometres. For waterways Sweden has made strenuous efforts from the sixteenth century, especially for the canal system connecting the Baltic with the North Sea. The total length of canals amounts to from 600 to 700 kilometres, of which the Göta, the Trollhätta, the Strömsholm, the Dalsland, and the Kinda Canal are the most important. The importance of the water traffic is apparent from the number of vessels and the lock dues. There are no recent returns of any extent on this

PRODUCTI(

| Districts. | | Norr-botten. | Wester-botten. | Wester-Norr-land. | Jemt-land. | Gefle-borg. | Upsala. | Stock-holm. | Kopparberg. |
|---|---|---|---|---|---|---|---|---|---|
| Iron Ore Production | One yr's average during | 1833—37, M.Tons | 1,931 | 295 | 515 | 376 | 3,855 | 19,578 | 16,971 | 64,710 |
| | | 1862—66, „ | 1,067 | .. | .. | 99 | 11,250 | 28,508 | 19,760 | 123,591 |
| | | 1875, „ | 714 | .. | 1,066 | 54 | 22,734 | 45,261 | 20,699 | 224,697 |
| Number of Pits | | | 6 | 49 | 3 | 3 | 39 | 57 | 127 | 215 |
| Total Production, | | 1833—37.....per cent | 0·87 | 0·13 | 0·23 | 0·17 | 1·73 | 8·19 | 7·62 | 29·04 |
| „ | „ | 1862—66..... „ | 0·23 | .. | .. | 0·02 | 2·42 | 6·14 | 4·26 | 26·62 |
| „ | „ | 1875 ..... „ | 0·08 | .. | 0·13 | 0·01 | 2·81 | 5·60 | 3·67 | 27·83 |
| Number of Workpeople | | | 24 | .. | 11 | 10 | 274 | 547 | 507 | 1,547 |
| Of these there were Women and Children | | | .. | .. | 1 | .. | .. | 35 | 132 | 102 |
| Export of Iron Ores | According to situation of Seaport | 1873, M. Tons | .. | .. | .. | .. | 1,185 | .. | 22,638 | .. |
| | | 1874 „ | .. | .. | .. | .. | .. | .. | 24,422 | .. |
| | | 1875 „ | .. | .. | .. | .. | .. | .. | 27,188 | .. |
| *Production of Iron and Steel during 1875:* | | | | | | | | | | |
| I. Blast-Furnaces | No. of Furnaces out of blast | | 4 | 1 | .. | .. | 8 | 4 | 3 | 20 |
| | „ „ blowing .. | | 3 | 3 | 6 | 2 | 25 | 7 | 2 | 47 |
| | No. of Working days @ year | | 305 | 405 | 851 | 54 | 4,732 | 1,178 | 329 | 7,742 |
| | Pig-iron made, Met. Tons | | 1,734 | 2,696 | 6,220 | 95 | 46,310 | 10,228 | 2,602 | 69,520 |
| | Castings „ „ | | 129 | 379 | 92 | 15 | 563 | 216 | 16 | 635 |
| | Total..... | | 1,863 | 3,075 | 6,312 | 110 | 46,873 | 10,444 | 2,618 | 70,155 |
| | No. of Workpeople ..... | | 42 | 72 | 140 | 14 | 646 | 184 | 61 | 995 |
| II. Foundries | No. of Works..... | | .. | 1 | 1 | 1 | 3 | .. | 2 | 7 |
| | Production, Metric Tons .. | | .. | 15 | 92 | 6 | 1,013 | .. | 604 | 1,241 |
| III. Ironworks | Out of Work..... | | 1 | 3 | 7 | .. | 21 | 3 | 2 | 21 |
| | Working..... | | 7 | 4 | 12 | 2 | 42 | 10 | 5 | 41 |
| | Furnaces and Fires ..... | | 9 | 7 | 21 | 2 | 108 | 38 | 14 | 94 |
| | Production, Metric Tons .. | | 371 | 1,079 | 3,140 | 48 | 19,014 | 6,063 | 3,418 | 19,499 |
| | No. of Workpeople..... | | 40 | 44 | 119 | 7 | 706 | 297 | 126 | 702 |
| IV. Steelworks | No. of Works ..... | | .. | .. | 1 | .. | 3 | 2 | .. | 8 |
| | Production | Bessemer, Met. Tons | .. | .. | .. | .. | 8,637 | .. | .. | 5,184 |
| | | Martin „ | .. | .. | .. | .. | .. | .. | .. | .. |
| | | Other „ | .. | .. | 13 | .. | .. | 158 | .. | 160 |
| | Total Production. | | .. | .. | 13 | .. | 8,637 | 158 | .. | 5,344 |
| V. Iron and Steel Manufactured | Rails, Metric Tons ..... | | .. | .. | .. | .. | .. | .. | .. | 2,893 |
| | Plates, Sheets, Metric Tons | | .. | .. | .. | .. | .. | .. | .. | 1,194 |
| | Wire, Nails „ | | 24 | 42 | 144 | .. | 155 | .. | 8 | 480 |
| | Tools „ | | .. | .. | 6 | .. | 6 | .. | .. | 286 |
| | Other Hardware.. „ | | 61 | 51 | 529 | 14 | 5,526 | 32 | 4 | 13 |
| | Total..... | | 85 | 93 | 679 | 14 | 5,687 | 32 | 12 | 4,866 |
| | No. of Works ..... | | 4 | 3 | 12 | 2 | 10 | 1 | 2 | 19 |
| | No. of Workpeople ..... | | 31 | 46 | 144 | 7 | 374 | 17 | 612 | 292 |

subject. For 1871, however, the traffic of 27 canals is officially returned as follows: Number of steamers, 18,541; of sailing vessels and boats, 43,820. Receipts of lock dues, £48,092. The traffic on the railways and canals may be judged from our review of the production and export. When the import is added to these the traffic on the railways and canals appears to be enormous, if their small mileage is taken into consideration. If these great lines of communication were not assisted by the universal and extensive use of the sledge—greatly dependent, of course, upon the winter and the snowfall—the Swedish goods traffic would be unmanageable, and the mining industries especially would lead a miserable existence.

It is to be regretted that there are no returns of the goods traffic on railways and canals, as by means of them the sale and consumption within and out of the producing districts could be ascertained with greater accuracy.

The selling prices of the wholesale trade are regulated by the quotations of the

AND STEEL.

| Skaraborg. | Wermland. | Elfsborg. | Göteborg-Bohus | Södermanland. | Oestergölland. | Calmar. | Jönköping. | Kronoberg. | Blekinge. | Malmöhus. | Christian stad. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .. | 29,155 | 97 | .. | 6,247 | 3,068 | 1,223 | 9,557 | 29 | .. | .. | .. | 222,806 |
| .. | 86,668 | .. | .. | 10,894 | 4,423 | 1,526 | 10,252 | 83 | .. | .. | 44 | 464,301 |
| .. | 109,024 | .. | .. | 17,594 | 8,051 | 2,032 | 10,011 | .. | .. | .. | .. | 807,503 |
| .. | 58 | .. | .. | 18 | 7 | 2 | 33 | 1 | .. | .. | 1 | 904 |
| .. | 13·08 | 0·4 | .. | 2·80 | 1·38 | 0·55 | 4·29 | 0·01 | .. | .. | .. | from 100·0 |
| .. | 18·67 | .. | .. | 2·34 | 0·95 | 0·33 | 2·20 | 0·02 | .. | .. | 0·01 | to 208·39 |
| .. | 13·51 | .. | .. | 2·18 | 1·00 | 0·25 | 1·24 | .. | .. | .. | .. | & to 362·42 |
| .. | 709 | .. | .. | 214 | 78 | 18 | 72 | 1 | .. | .. | 3 | 6,961 |
| .. | 49 | .. | .. | 15 | .. | .. | .. | .. | .. | .. | .. | 428 |
| .. | .. | .. | 19 | .. | .. | .. | .. | .. | .. | 10 | .. | 23,861 |
| .. | .. | .. | .. | 850 | .. | .. | .. | .. | .. | 27 | .. | 25,299 |
| .. | .. | .. | 10 | .. | .. | .. | .. | .. | .. | .. | .. | |
| | | | | | | | | | | | | 27,198 |
| .. | 10 | 2 | .. | 9 | .. | 5 | 2 | 1 | .. | .. | .. | 101 |
| 1 | 24 | .. | .. | 5 | 4 | 6 | 10 | 7 | .. | .. | .. | 224 |
| 195 | 5,314 | 282 | .. | 782 | 1,522 | 772 | 1,181 | 750 | .. | .. | .. | 41,158 |
| 1,162 | 46,235 | 1,940 | .. | 4,376 | 13,414 | 4,320 | 4,338 | 2,153 | .. | .. | .. | 343,642 |
| 11 | 506 | 67 | .. | 184 | 309 | 71 | 135 | 352 | .. | .. | .. | 6,899 |
| 1,173 | 46,741 | 2,007 | .. | 4,560 | 13,723 | 4,391 | 4,473 | 2,505 | .. | .. | .. | 350,541 |
| 18 | 495 | 51 | .. | 89 | 96 | 99 | 270 | 150 | .. | .. | .. | 4,854 |
| 1 | 5 | .. | 2 | 5 | 3 | 7 | 4 | 6 | 2 | 3 | 1 | 61 |
| 352 | 197 | .. | 1,197 | 2,299 | 2,510 | 2,314 | 454 | 649 | 160 | 1,354 | 589 | 17,331 |
| 5 | 50 | 7 | 2 | 6 | 12 | 3 | 3 | 2 | .. | .. | .. | 195 |
| 5 | 46 | 8 | .. | 7 | 21 | 14 | 15 | 10 | 2 | .. | .. | 318 |
| 7 | 127 | 14 | .. | 11 | 54 | 32 | 23 | 11 | 3 | .. | .. | 770 |
| 790 | 32,422 | 4,099 | .. | 1,216 | 12,978 | 5,565 | 2,189 | 944 | 4,933 | .. | .. | 189,845 |
| 38 | 1,071 | 111 | .. | 69 | 895 | 416 | 163 | 68 | 21 | .. | .. | 6,926 |
| .. | 7 | 2 | .. | .. | 4 | .. | .. | .. | .. | .. | .. | 33 |
| .. | 2,598 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 19,370 |
| .. | 33 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 33 |
| .. | 376 | 248 | .. | .. | 183 | .. | .. | .. | .. | .. | .. | 1,982 |
| .. | 3,007 | 248 | .. | .. | 183 | .. | .. | .. | .. | .. | .. | 21,385 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2,893 |
| .. | .. | .. | .. | 425 | 4,684 | .. | .. | .. | 840 | .. | .. | 9,077 |
| 255 | 1,734 | 159 | 20 | 282 | 1,565 | 981 | 114 | 223 | 1,068 | .. | .. | 8,318 |
| 35 | 133 | 9 | 420 | 109 | 22 | 409 | 57 | 8 | .. | .. | .. | 1,847 |
| 97 | 2,252 | 281 | 28 | 18 | 557 | 1,447 | 161 | 180 | 52 | 1,252 | 405 | 16,110 |
| 387 | 4,119 | 449 | 468 | 834 | 6,828 | 2,837 | 332 | 361 | 2,560 | 1,252 | 405 | 38,240 |
| 6 | 34 | 10 | 3 | 8 | 22 | 15 | 13 | 12 | 4 | 2 | 1 | 215 |
| 205 | 599 | 124 | 691 | 490 | 417 | 527 | 149 | 158 | 244 | 236 | 114 | 6,054 |

Stockholm Exchange. The yearly averages of these for the leading descriptions of iron are before us. For coal they have already been quoted. For export the average price on the Stockholm Exchange was per Swedish cwt. of 42·5 kilogrammes :—

| | Pig-iron. | | Bars. | | Hoops. | | German Steel. | | | Other Steel. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | s. | d. | s. | d. | s. | d. | £ | s. | d. | £ | s. | d. |
| 1869 | 3 | 0·1 | 7 | 8 0 | 10 | 2·7 | 1 | 14 | 0·9 | 0 | 11 | 4·3 |
| 1870 | 2 | 8·3 | 7 | 4·6 | 10 | 2·7 | 1 | 11 | 9·7 | 0 | 11 | 4·3 |
| 1871 | 2 | 11·7 | 7 | 8·0 | 9 | 1·0 | 1 | 14 | 0·9 | 0 | 11 | 4·3 |
| 1872 | 4 | 9·9 | 11 | 4·3 | 12 | 5·9 | 1 | 11 | 9·7 | 0 | 13 | 7·5 |
| 1873 | 7 | 4·6 | 14 | 9·2 | 16 | 4·4 | 1 | 14 | 0·9 | 1 | 0 | 5·4 |
| 1874 | 4 | 6·5 | 12 | 5·9 | 13 | 4·2 | 1 | 17 | 5·8 | 0 | 18 | 2·1 |
| 1875 | 3 | 11·7 | 11 | 4·3 | 13 | 0·7 | 1 | 14 | 0·9 | 0 | 17 | 0·5 |

## IMPORT AND EXPORT (TONS) OF SWEDISH IRON AND S

| Imports. | Norway. | Finland. | Russia. | Den-mark. | Prussia. | Meck-lenburg. | Lü |
|---|---|---|---|---|---|---|---|
| Pig-iron | 1,147 | .. | .. | 416 | 1,770 | .. | |
| Bar-iron | 18 | .. | .. | 1,122 | 56 | .. | |
| Blooms | .. | 633 | .. | .. | .. | .. | |
| Rails | 9 | .. | .. | 1,132 | 9 | .. | |
| Plates and Sheets | 9 | .. | .. | 285 | .. | .. | |
| Tinplate | .. | .. | .. | 35 | .. | .. | |
| Iron and Steel Wire | .. | .. | .. | 30 | .. | .. | |
| Hoop, Bulb, and other Iron | .. | .. | .. | 796 | .. | .. | |
| Nails | 797 | .. | .. | 33 | .. | .. | |
| Scrap-iron | .. | .. | .. | 575 | .. | .. | |
| Cast-iron hardware | 65 | .. | .. | 76 | 3 | .. | |
| Wrought-iron ,, | 9 | .. | .. | 149 | 15 | .. | 1 |
| Cutlery and Edge Tools | 1 | .. | .. | 10 | .. | .. | |
| Steel { Raw | .. | .. | .. | 106 | .. | .. | |
| Steel { Wrought | .. | 1 | .. | 1 | .. | .. | |
| Steam Engines | .. | .. | .. | .. | .. | .. | |
| Machines and Tools | .. | .. | .. | .. | .. | .. | |
| Total | 2,055 | 639 | .. | 4,766 | 1,853 | .. | 1 |
| **Exports.** | | | | | | | |
| Pig-iron | 1,982 | 6,114 | 2,887 | 156 | 1,380 | .. | |
| Bar-iron | 452 | 415 | 482 | 7,970 | 1,841 | 120 | 2, |
| Blooms | 51 | 37 | .. | .. | .. | .. | |
| Rails | 8 | 52 | .. | .. | .. | .. | |
| Plates and Sheets | 22 | 406 | 105 | 146 | 12 | .. | |
| Tinplate | .. | .. | .. | .. | .. | .. | |
| Iron and Steel Wire | 13 | .. | 277 | 7 | .. | .. | |
| Hoop, Bulb, and other Iron | .. | 77 | 898 | 446 | 651 | 19 | |
| Nails | 49 | 776 | 7 | 210 | .. | .. | |
| Scrap-iron | .. | .. | .. | .. | 219 | .. | |
| Cast-iron hardware | .. | 71 | .. | 223 | .. | .. | |
| Wrought-iron ,, | 8 | 182 | .. | 15 | 2 | .. | |
| Cutlery and Edge Tools | .. | .. | .. | .. | .. | .. | |
| Steel { Raw | 16 | 317 | 785 | 96 | .. | .. | |
| Steel { Wrought | .. | .. | .. | .. | .. | .. | |
| Steam Engines | .. | .. | .. | .. | .. | .. | |
| Machines and Tools | .. | .. | .. | .. | .. | .. | |
| Total | 2,551 | 8,447 | 4,941 | 9,269 | 4,105 | 139 | 8, |

According to the situation of the seaport

| | | Nor-botten. | Wester-botten. | Wester-Norrland. | Gefle-borg. | Stock-holm. | G b B |
|---|---|---|---|---|---|---|---|
| Pig-iron | Metric Tons.. | 916 | 199 | 2,132 | 8,841 | 17,811 | 18 |
| Bar-iron | ,, ,, | 1 | 218 | 2,635 | 21,916 | 33,135 | 42 |
| Blooms | ,, ,, | .. | .. | .. | 62 | 1,385 | 8 |
| Rails | ,, ,, | .. | .. | .. | .. | 50 | |
| Plates and Sheets | ,, ,, | .. | 1 | 2 | 2 | 560 | |
| Tinplate | ,, ,, | .. | .. | .. | .. | 2 | |
| Iron and Steel Wire | ,, ,, | .. | .. | .. | .. | 29 | |
| Hoop, Nail, and other Iron | ,, ,, | .. | .. | .. | 775 | 3 429 | 18 |
| Nails | ,, ,, | .. | 3 | 6 | .. | 757 | |
| Shoe-nails | ,, ,, | .. | .. | .. | .. | 58 | |
| Scrap-iron | ,, ,, | .. | .. | .. | 5 | 265 | 2 |
| Cast-iron hardware | ,, ,, | .. | .. | 13 | .. | 109 | |
| Wrought-iron hardware, Cutlery, and Edge Tools | ,, ,, | 2 | .. | .. | .. | 181 | |
| Steel | ,, ,, | .. | 1 | 1 | 1,427 | 1,255 | 3, |
| Steam Engines | £ sterling. | .. | .. | .. | .. | 319 | 1, |
| Other Tools and Implements | ,, ,, | 80 | 57 | 122 | .. | 85,617 | 18 |

NG 1875, FROM AND TO THE FOLLOWING COUNTRIES.

| ırg. | Bremen. | Holland. | Belgium. | Great Britain. | France. | United States. | Other Countries. | Total Weight. | Total Valu in £ Sterling. |
|---|---|---|---|---|---|---|---|---|---|
| | .. | .. | .. | 14,548 | 25 | .. | .. | 17,924 | 71,853 |
| | .. | 211 | 547 | 1,372 | 8 | .. | .. | 3,354 | 35,849 |
| | .. | .. | .. | .. | .. | .. | 4 | 642 | 6,182 |
| | .. | 104 | 660 | 58,185 | .. | .. | .. | 55,099 | 366,417 |
| | 13 | 151 | 169 | 2,519 | 5 | .. | .. | 3,186 | 42,616 |
| | .. | .. | .. | 913 | .. | .. | 3 | 951 | 28,585 |
| | .. | 22 | .. | 156 | .. | .. | 1 | 248 | 6,631 |
| | 41 | 163 | 1,003 | 1,300 | .. | .. | 4 | 3,323 | 38,247 |
| | .. | .. | .. | 35 | .. | .. | 5 | 876 | 17,697 |
| | .. | .. | .. | .. | .. | .. | .. | 601 | 4,184 |
| | .. | .. | .. | 62 | .. | .. | 14 | 247 | 4,103 |
| | .. | 15 | 19 | 1,185 | 9 | .. | .. | 1,524 | 94,752 |
| | .. | .. | .. | 69 | 1 | .. | .. | 87 | 18,214 |
| | .. | 16 | 1 | 142 | .. | .. | 1 | 278 | 4,636 |
| | .. | .. | .. | 4 | 1 | .. | 1 | 10 | 4,089 |
| | .. | .. | .. | .. | .. | .. | .. | .. | 59,393 |
| | .. | .. | .. | .. | .. | .. | .. | .. | 824,938 |
| | 54 | 682 | 2,899 | 75,490 | 49 | .. | 33 | 88,355 | 1,628,886 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ; | 20 | 375 | 1,954 | 32,881 | 716 | 260 | .. | 48,742 | 233,636 |
| 2 | 146 | 3,712 | 2,006 | 65,037 | 10,728 | 4,373 | 4,337 | 106,393 | 1,421,623 |
| 5 | .. | .. | 2,353 | 7,830 | 2,060 | ... | 3 | 12,439 | 120,500 |
| | .. | .. | .. | .. | .. | .. | .. | 60 | 395 |
| | .. | 10 | .. | 23 | .. | .. | 36 | 782 | 10,440 |
| | .. | .. | .. | .. | .. | .. | 4 | 4 | 106 |
| | .. | 25 | 17 | 486 | .. | .. | 33 | 858 | 22,906 |
| 4 | .. | 471 | 2,780 | 12,521 | 4,325 | 177 | 934 | 20,049 | 369,523 |
| 7 | .. | .. | .. | .. | .. | .. | 2 | 1,169 | 23,457 |
| | .. | 31 | 34 | 2,146 | 126 | .. | 365 | 2,921 | 19,507 |
| | .. | 337 | .. | 62 | .. | .. | 106 | 799 | 15,174 |
| 8 | .. | .. | .. | 35 | .. | .. | 5 | 262 | 10,262 |
| | .. | .. | .. | .. | .. | .. | 1 | 1 | 264 |
| 9 | .. | 101 | 61 | 4,208 | 10 | .. | 555 | 6,273 | 188,605 |
| | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| | .. | .. | .. | .. | .. | .. | .. | .. | 1,353 |
| | .. | .. | .. | .. | .. | .. | .. | .. | 74,798 |
| 1 | 166 | 5,152 | 9,205 | 125,229 | 17,965 | 4,810 | 6,391 | 204,752 | 2,512,549 |

export during 1875 is divided as follows.

| :man- ıd. | Oester- götland. | Calmar. | Jönköping. | Blekinge. | Malmöhus. | Frontier of Norway. | Total. |
|---|---|---|---|---|---|---|---|
| .. | 299 | 204 | .. | .. | 7 | .. | 48,742 |
| 1 | 1,299 | 1,186 | .. | 172 | 1,779 | 3 | 106,393 |
| .. | 1,974 | 162 | .. | .. | .. | .. | 12,493 |
| .. | .. | .. | .. | .. | .. | .. | 60 |
| .. | 5 | .. | .. | 3 | 145 | .. | 782 |
| .. | .. | .. | .. | .. | 1 | .. | 4 |
| .. | .. | 276 | 1 | .. | 8 | .. | 858 |
| .. | 199 | 643 | .. | .. | 146 | .. | 20,049 |
| .. | 65 | .. | .. | .. | 32 | .. | 1,044 |
| .. | .. | .. | .. | .. | .. | .. | 125 |
| . | 31 | 51 | .. | .. | 372 | .. | 2,921 |
| 8 | 403 | .. | .. | .. | 45 | .. | 799 |
| .. | .. | .. | .. | .. | 22 | .. | 263 |
| . | 3 | .. | .. | 1 | 95 | .. | 6,273 |
| . | .. | .. | .. | .. | .. | .. | 1,353 |
| 3 | 9,222 | 3,995 | 457 | 18 | 5,856 | 371 | 74,798 |

| I. Province. | Superficial Extent of the Mines actually worked. Hectares. | Number of Hands. | Steam Engines. | | Production. | |
|---|---|---|---|---|---|---|
| | | | No. | HP. | Metric Tons. | Value in £ st |
| Coal. | | | | | | |
| Oviedo (Asturia) | 21,002 | 3,883 | 6 | 144 | 374,914 | 149,966 |
| Córdoba | 716 | 1,066 | 14 | 272 | 176,336 | 116,382 |
| Palencia | 1,353 | 1,540 | 8 | 97 | 119,259 | 55,699 |
| Sevilla | 38 | 120 | 3 | 95 | 13,500 | 21,024 |
| Gerona | 303 | 42 | 1 | 50 | 6,380 | |
| Leon | 403 | 39 | ... | ... | 4,721 | |
| Burgos | 165 | 48 | ... | ... | 230 | |
| Total | 23,980 | 6,738 | 32 | 658 | 695,340 | 343,071 |
| Lignite. | | | | | | |
| Barcelona | 1,864 | 165 | 1 | 10 | 7,516 | 6,013 |
| Santander | 80 | 66 | ... | ... | 2,022 | 809 |
| Guipuzcoa | 123 | 12 | ... | ... | 1,584 | 3,191 |
| Teruel | 424 | 77 | ... | ... | 1,157 | |
| Logroño | 50 | 10 | ... | ... | 243 | |
| Alicante | 48 | 12 | ... | ... | 208 | |
| Balearic Islands | 114 | 51 | ... | ... | 200 | |
| Navarra | 12 | 4 | ... | ... | 200 | |
| Gerona | 113 | 34 | ... | ... | 140 | |
| Oviedo | 105 | 29 | ... | ... | 56 | |
| Castellon | 110 | 27 | ... | ... | 20 | |
| Total | 3,042 | 587 | 1 | 10 | 13,346 | 10,013 |
| Total of coal and lignite | 27,022 | 7,325 | 33 | 668 | 708,686 | 353,084 |

| I. Year. | Asturia. | | Córdoba. | | Palencia. |
|---|---|---|---|---|---|
| | Production of Coal. | Of this quantity shipped. | Production of | | Production of Coal. |
| | | | Coal. | Coke. | |
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. |
| 1828 | ... | 3,708 | ... | ... | ... |
| 1838 | 21,500 | 13,261 | ... | ... | ... |
| 1845 | 33,539 | 28,663 | 1,523 | 28 | 690 |
| 1855 | 65,024 | 47,980 | 5,000 | ... | 6,720 |
| 1860 | 278,428 | 66,520 | 8,310 | ... | 21,765 |
| 1865 | 339,328 | 65,480 | 12,287 | 92 | 88,518 |
| 1870 | 447,037 | 115,997 | 77,648 | 2,589 | 85,638 |
| 1871 | 370,967 | 130,214 | 119,238 | 4,707 | 82,505 |
| 1872 | 424,499 | 143,521 | 142,071 | 5,717 | 101,139 |
| 1873 | 375,014 | 120,135 | 144,855 | ... | 113,678 |
| 1874 | 374,914 | 100,050 | 176,336 | ... | 119,259 |
| 1875 | 376,649 | 101,000 | 133,083 | ... | 133,213 |
| 1876 | 380,000 | 102,500 | 153,012 | ... | 155,676 |
| 1877 | 357,000 | 100,340 | 158,000 | ... | 160,000 |

According to the official statistics for 1873—the latest mining returns issued by the Spanish Government—239 coal and 44 lignite mines were actually worked at the end of that year. Concessions had been given for 792 coal and 231 lignite mines.

The present annual output of coal in Spain amounts, as has been stated before, to about 1½ million of metric tons. In the course of 1872 to 1874 it was 1·3 million of metric tons on the average, which were consumed at the following rate :—

| | | |
|---|---|---|
| By the iron and metal industries ..... | 500,000 | metric tons. |
| „ railways ..... | 190,000 | „ |
| „ gasworks ..... | 110,000 | „ |
| „ Royal navy..... | 28,000 | „ |
| „ merchant fleet ..... | 110,000 | „ |
| „ divers manufacturing industries in Catalonia ..... | 146,000 | „ |
| „ divers manufacturing industries in other provinces..... | 216,000 | „ |
| Total ..... | 1,300,000 | „ |

Amongst the manufacturing districts of Spain, Catalonia and Asturia are the best consumers of coal, the quantity for either being about 300,000 metric tons per annum. Of the towns of the kingdom Barcelona (97,990 metric tons) and Madrid (46,249 metric tons) had the largest consumption in 1872.

A considerable increase of the Spanish coalmining industry is not beyond possibility. Several of the coal districts are at a short distance from the sea-coast, and are thus the only ones on the continent of Europe enjoying the exceptionally advantageous situation of the Welsh and North of England districts. These Spanish districts would be able to supply their coal not only to the peninsular seaports at low rates of coasting freights, but also to the Mediterranean countries, which, generally speaking, are devoid of coal, and even to the Asiatic countries by way of the Suez Canal.

The first object, however, to be aimed at for the present would be a considerable reduction of the English import, by which one-half of the actual consumption is supplied.

The want of capital and enterprise and the difficulties of transport have been and are still the obstructions in the way of a more extensive advance of coal-mining in Spain. They will have to be overcome by the legislature of the State in allowing the combination of capital, by a general improvement of the financial and economical position of the country, and at last by the railway companies, in having an eye to a decided improvement of the present administration of traffic and to an extension of their lines all over the country. If this be accomplished, the mining industries of Spain will doubtless attain that importance to which they are entitled by their natural conditions.

The first railway in Spain—the Barcelona-Mataro line, 28 kilometres long, was built in 1848. The entire mileage of the railways was—

| | | | |
|---|---|---|---|
| In 1855 ..... | 474 | kilometres. | In 1870 ..... 5,469 kilometres. |
| „ 1860 ..... | 1,913 | „ | „ 1875 ..... 5,796 „ |
| „ 1865 ..... | 4,828 | „ | „ 1877 ..... 6,199 „ |

The total quantity of coal carried by the Spanish railways in 1872 was 363,386 metric tons, 173,058 of this being for their own use.

## IRON.

The abundance of the very best iron ores in Spain is well known, the beds of the finest spathic, red, magnetic, and brown ores of that country being amongst the richest of Europe. As rich coal deposits are not wanting either, it can only be explained by the unsettled political situation of the country, by the want of industrial enterprise, and the insufficient extent of the railway system, that Spain is not able to compete with the English iron trade as it ought to do. The principal cause of this is, no doubt, the continuance of the unfortunate political dissensions in the country.

The production of iron ores, pig and wrought iron, and steel in Spain has been :—

| In the Year. | Iron Ores. | | Production of | | |
|---|---|---|---|---|---|
| | Production. | Export. | Pig-Iron. | Wrought-Iron. | Steel. |
| | Metric Tons. | Metric Tons | Metric Tons. | Metric Tons. | Metric Tons. |
| 1864 ..... | ... | ... | 50,775 | 44,564 | 201 |
| 1865 ..... | ... | 70,000 | 49,533 | 42,298 | 301 |
| 1866 ..... | ... | 73,000 | 39,259 | 32,338 | 577 |
| 1867 ..... | ... | 118,000 | 41,933 | 35,637 | 331 |
| 1868 ..... | ... | ... | 43,161 | 36,151 | 369 |
| 1869 ..... | ... | 160,000 | 34,486 | 35,626 | 247 |
| 1870 ..... | ... | ... | 54,007 | 36,162 | 231 |
| 1871 ..... | 585,762 | 391,436 | 53,606 | 42,523 | 216 |
| 1872 ..... | 781,468 | 745,802 | 56,462 | 41,464 | 272 |
| 1873 ..... | 811,926 | 800,381 | 42,825 | 32,154 | 216 |
| 1874 ..... | 402,952 | ... | ... | ... | ... |
| 1875 ..... | 496,528 | ... | ... | ... | ... |
| 1876 ..... | 908,899 | ... | ... | ... | ... |
| 1877 ..... | 1,162,170 | ... | ... | ... | ... |

The production of iron ores may be ascribed to the different provinces as follows :—

| Province. | Superficial area of mines actually worked in 1874. Hectares. | Number of hands in 1874. | Production of Iron Ores. | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1874. | | 1875. | 1876. | 1877. |
| | | | Met. Tons. | Value in £. | Metric Tons. | | |
| Vizcaya..... | 6,443 | 239 | 10,821 | 3,030 | 34,296 | 432,418 | 702,090 |
| Murcia ..... .. | 1,305 | 954 | 110,836 | 15,517 | 144,546 | 208,685 | 200,000 |
| Oviedo ..... | 3,374 | 484 | 75,276 | 9,033 | 61,304 | 60,245 | 59,400 |
| Almeria ..... | 66 | 173 | 75,120 | 18,029 | | | |
| Malaga ..... | 13 | 460 | 52,645 | 21,058 | | | |
| Santander ..... | 419 | 238 | 48,836 | 24,418 | | | |
| Guipuzcoa..... | 841 | 165 | 10,681 | 6,809 | | | |
| Navarra ..... | 403 | 190 | 9,175 | 5,872 | | | |
| Sevilla ..... ... | 35 | 60 | 3,320 | 691 | | | |
| Burgos ..... | 64 | 18 | 1,300 | 520 | 236,382 | 207,551 | 200,680 |
| Badajoz ..... | 45 | 28 | 1,200 | 864 | | | |
| Logroño ..... | 232 | 36 | 1,150 | 515 | | | |
| Lugo ..... | 126 | 14 | 1,000 | 300 | | | |
| Teruel ..... | 16 | 11 | 602 | 337 | | | |
| Coruña..... | 12 | 12 | 600 | 192 | | | |
| Leon..... | 180 | 24 | 390 | 195 | | | |
| Total ..... | 13,574 | 3,112 | 402,952 | 107,380 | 496,528 | 908,899 | 1,162,170 |

The output of iron ores, generally speaking, greatly increased up to the year 1873, when it attained the amount of 811,926 metric tons. Owing to the Carlist War, however, it declined from that time until 1874 by one-half, and only recovered at the cessation of the hostilities in 1876 ; in 1877 it increased to 1,162,170 metric tons.

The pernicious influence of the internal strife, by which the Basque provinces were chiefly affected, is most strikingly illustrated by the above returns of the output of ores in the province of Vizcaya. Having declined in 1874, in consequence of the war, to 10,821 metric tons, it increased again in 1876 to 432,418, and in 1877 to 702,090 metric tons, a result clearly indicative of the favourable chances

of ore-mining. Amongst all the provinces of Spain Vizcaya has the richest deposits of excellent ores, which in the valley of Somorostro are almost cropping out at the surface, and the quantity of ores raised within it amounts to nearly two-thirds of the output of the whole country. According to the estimate of Senor RAMON ADAN DE YARZA the Somorostro deposits alone contain 163,250,000 metric tons of ores.

Up to the end of 1873 the total number of concessioned ore mines was 1,440, with a superficial area of 35,303 hectares. The number of mines actually worked, however, in the same year was only 390. They gave employment to 4,816 hands.

Until the year 1860 the output of iron ores was insignificant, as owing to the low social state of the country the home demand is only feeble, and the inhabitants are not able to appreciate the mineral wealth of their own country as much as it deserves.

The annual output until then amounted to from 30,000 to 50,000 metric tons. A considerable extension of mining operations took place when, on January 1st, 1863, the export duties on minerals were abolished and the export of iron ores became possible. In a very short time the English, French, and German ironmasters had found out the excellent quality of the ores of northern Spain and the export advanced briskly, as shown by our previous figures. A rapid increase took place when the demand for an exceptionally pure description of ores was heightened by the introduction of the Bessemer process, for which purpose the Vizcaya ores are eminently suitable on account of their quality as well as their proximity to the port of Bilbao, from whence they are shipped. At present by far the greatest portion of the iron ores raised in Spain is exported.

The firm of Herr F. KRUPP, in Essen, is known to possess considerable mining property near Bilbao, from which 200,000 metric tons of ores per annum may be supplied to the works. The ores are shipped by four steamers of 1,700 tons burden each, owned by the firm—a fifth one being on the stocks—besides a number of chartered vessels. The ores are transported from the mines by a railway of 14·5 kilometres length to the Nervion river, where they are dropped into the vessels from a platform.

The excellent quality of the Spanish ores may be judged from the following analysis of Vizcaya ores, made in the laboratory of the El Carmen ironworks at Baracaldo, near Bilbao :—

| | Vena dulce. | | Campanil. | | | Mineral rubio. | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 3 | 1 | 2 |
| Peroxide of iron | 82·26 | 80·78 | 80·75 | 84·01 | 73·90 | 79·14 | 83·75 |
| Silicon | 1·35 | 2·63 | 3·24 | 3·20 | 5·70 | 7·20 | 5·25 |
| Aluminium | 1·53 | 1·38 | 3·10 | 0·40 | 3·80 | 2·40 | 3·20 |
| Oxide of manganese | 1·78 | 2·24 | 8 15 | 4·38 | 5·80 | 2·45 | 3·17 |
| Oxide of calcium | 9·27 | 6·39 | 0·82 | 0·40 | 0·45 | 2·23 | 1·36 |
| Magnesium | trace | 0·46 | 1·04 | 0·80 | 1·25 | 0·71 | trace |
| Sulphur | ... | ... | ... | ... | ... | trace | 0·04 |
| Phosphorus | ... | ... | ... | ... | ... | ... | ... |
| Water, carbonic acid, and loss | 3·81 | 6·12 | 2·90 | 6·81 | 1·25 | 5·27 | 3·23 |
| Total | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 |
| Metallic iron | ... | ... | 56·52 | 58·80 | 51·73 | 55·40 | 58·62 |

By "Vena dulce" the most pure (oligistic) ore is understood; "Campanil" means red hematite, generally with calcareous gangue; "Mineral rubio" (blonde mineral) means the brown hydratic oxides.

The production of *pig-iron* is insignificant, only a small portion of the output

of ores being worked upon Spanish soil. In spite of the abundance of available coal the supply is not even sufficient to satisfy the small demand of the country, and considerable quantities are being purchased from abroad—chiefly from England—from whence 25,819 metric tons were imported in 1877.

According to the statistical returns of 1873—the last issued by the Government—42,825 metric tons of pig-iron have been produced in Spain during that year from 94,394 metric tons of ores. Of this quantity, 23,456 metric tons had been produced in the province of Oviedo, and 9,006 metric tons in Vizcaya.

The pig-iron is partly made by charcoal, partly by coke. The first blast-furnaces were erected in the year 1828 near Marbilla, in Granada, for working the Ronda magnetic ores.

The manufacture of *wrought-iron*, which, like the production of pig-iron, is carried on almost entirely and to a mutually equal extent in the provinces of Oviedo and Vizcaya, is likewise insufficient to supply the home demand, and large quantities are imported, as will be seen from our subsequent table of the import figures. The entire production of wrought-iron is not made from pig-iron, a large portion of it being manufactured directly from the ores in Catalan forges.

The following statements show the extent of the Spanish iron industry in 1873:

| | |
|---|---|
| Blast-furnaces and ironworks in activity | 68 |
| " " not working | 42 |
| Hands employed | 4,009 |
| Water-wheels | 120 |
| Horse-power of water-wheels | 1,092 |
| Steam engines | 113 |
| Horse-power of steam engines | 2,721 |

Several large works, coming up to the standard of the age, are found at Pedroso, near Sevilla; at Mières, near Oviedo; at Alicante, and several other places.

The production of *steel* is utterly insignificant, being only 216 metric tons in 1873.

The demand for rails, plates and sheets, steel and hardware, is for the greatest part supplied by importation, as shown by the following table of the import figures:—

| Year. | Pig and Scrap Iron. | Bar and Hoop Iron, &c. | Rails. | Plates, Sheets, Wire, Nails, Tubes, &c. | Steel. | Hardware of Iron and Steel. |
|---|---|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. |
| 1864 | 21,857 | ... | ... | ... | ... | ... |
| 1865 | 12,929 | 19,575 | ... | 1,335 | 539 | 421 |
| 1866 | 5,466 | 12,265 | ... | 1,332 | 572 | 352 |
| 1867 | 10,479 | 77,224 | ... | ... | 2,233 | ... |
| 1868 | 12,345 | | ... | ... | | ... |
| 1869 | 8,622 | | ... | ... | | ... |
| 1870 | 16,790 | 28,936 | ... | ... | 468 | ... |
| 1871 | 18,013 | 37,147 | ... | ... | 1,101 | ... |
| 1872 | 12,579 | ... | ... | ... | ... | ... |
| 1873 | 13,995 | 27,385 | 13,433 | 5,224 | 1,931 | 8,494 |
| 1874 | 14,768 | 40,251 | 23,365 | 6,272 | 3,222 | 9,790 |
| 1875 | 19,008 | ... | 11,360 | 5,904 | ... | 5,483 |

An export of iron and hardware from Spain (apart from that of the ores) is entirely out of question, in spite of the great facilities afforded by natural conditions to an extensive iron industry.

Considering, however, the enormous mineral wealth of this country it may be hoped that the blessings enjoyed at present by the iron-producing nations of the world may also be in store for Spain, although, perhaps, at a somewhat remote future.

# PORTUGAL.

## 89,625 SQUARE KILOMETRES. 4,298,881 INHABITANTS.

THE *coal* districts of this kingdom are only of a limited extent, and mining operations, having hardly yielded any profit at all, have been entirely suspended for some time. The production of the year 1872 has been stated at 12,387 metric tons, of a value of £145,652, only four mines having been worked. More detailed and recent returns have not been forthcoming.

Under such circumstances the demand for coal has to be satisfied from abroad. From England there were imported into Portugal, the Azores, and Madeira, in 1875 :—

| | | | |
|---|---|---|---|
| 265,276 | metric tons | of coal of a value of | £182,768 |
| 3,398 | „ | coke „ | 3,320 |

There are only two coalfields in Portugal worth mentioning, viz., the anthracite deposit of the Douro and the coalfield of Cape Mondego, in the province of Beira. The first named extends over a superficial area of about 12,000 hectares on both banks of the river Douro, near its outlet into the sea. A very fair description of household coal is raised from this coalfield, which has been worked since 1801, and which has the largest share of the total production above mentioned. The Mondego coal contains large quantities of pyrites, from which however it may be partially freed by washing. It is raised only in insignificant quantities.

Other coal seams seem to be of no particular value, as they either have not been worked at all or have not been sufficiently investigated.

*Iron ores* are found in most of the provinces, some descriptions being of excellent quality, and in beds of considerable thickness. A bed of 20 metres thickness, near Quadramil, in the province of Traz-os-Montes, consisting of hematite and brown ores, is especially worth noticing. But the production of iron in Portugal is altogether insignificant, being in 1872 only 2,423 metric tons, of a value of £1,110. The demand for iron and hardware is almost exclusively satisfied from England.

Railway construction was commenced in Portugal in the year 1854. The mileage of the lines opened to traffic was :—

| | | | |
|---|---|---|---|
| In 1860 ..... | 131 kilometres. | In 1873 ..... | 874 kilometres. |
| „ 1870 ..... | 772 „ | „ 1877 ..... | 968 „ |

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# ITALY.

## 296,322·91 SQUARE KILOMETRES. 27,482,174 INHABITANTS.

### FUEL.

ITALY is, on the whole, very deficient in *coal* deposits. Good coal is found in the province of Udine (Friuli), but only in unimportant quantity. The same province contains some *anthracite* seams, from which, however, little is raised, the most noteworthy of them, situate in the valley of Aosta, only yielding 500 metric tons per annum.

On the other hand, this country possesses a considerable number of *lignite* seams, all of which are found in formations belonging to the Tertiary period.

The most extensive of these are in Tuscany, Liguria, in the provinces of Vicenza, Verona, Bergamo, and in the island of Sardinia.

The total area covered by these beds is 13,500 hectares. Besides these there are extensive peat moors at the foot of the Alps. The quantity of lignite produced will be seen from the following figures :—

| | Metric Tons. | Value in £ sterling. |
|---|---|---|
| Average per year from 1866 to 1870 | 70,000 | 34,000 |
| In 1871 | 84,000 | 40,400 |
| „ 1872 | 95,500 | 46,400 |
| „ 1873 | 110,305 | 56,400 |
| „ 1874 | 121,855 | 63,600 |
| „ 1875 | 101,640 | 53,600 |

The production of peat amounts to about 95,000 metric tons per annum. Specially selected samples, which were analysed in the chemical laboratory of the Royal Technical Institute at Florence, gave the following results :—

| Description. | Found at. | Density. | Carbon. | Hydrogen. | Oxygen. | Ashes. | Caloric Units. |
|---|---|---|---|---|---|---|---|
| Lignite | Montebamboli... | 1·32 | 73·44 | 6·15 | 13·20 | 5·10 | 7·485 |
| „ | Tatti | 1·66 | 73·10 | 5·88 | 15·89 | 2·50 | 7·220 |
| Peat | Ghedi | ... | 55·60 | 6·72 | 33·83 | 2·80 | 5·353 |
| Artificial fuel (peat).. | „ | 1·28 | 50·00 | 6·80 | 32·43 | 8·77 | 4·978 |

It is evident that so small a production of coal in the country necessitates a considerable import of mineral fuel (mostly from Great Britain) notwithstanding the fact that the consumption is limited. This is also made apparent by the following figures concerning the import and export of coal in Italy :—

| Year. | Import. | | Export. | |
|---|---|---|---|---|
| | Metric Tons. | Value in £ sterling. | Metric Tons. | Value in £ sterling. |
| 1866 | 524,042 | 838,467 | 1,879 | 3,006 |
| 1867 | 515,943 | 825,509 | 2,068 | 3,308 |
| 1868 | 580,388 | 928,621 | 3,934 | 6,294 |
| 1869 | 653,694 | 1,045,910 | 6,442 | 10,307 |
| 1870 | 941,789 | 1,506,862 | 11,456 | 18,331 |
| 1871 | 791,589 | 1,044,897 | 12,550 | 17,554 |
| 1872 | 1,039,724 | 2,079,448 | 5,902 | 9,652 |
| 1873 | 959,532 | 1,919,064 | 4,189 | 8,378 |
| 1874 | 1,032,035 | 1,651,256 | 4,778 | 7,644 |
| 1875 | 1,059,816 | 1,610,920 | 7,736 | 11,758 |
| 1876 | 1,454,542 | 1,861,814 | 5,794 | 7,416 |

## IRON.

Italy is possessed of great wealth in the shape of excellent *ores*, and if she were equally well provided with fuel, her iron industry would not have lagged behind that of other countries more favoured by nature. But as the indispensable requisite, a good description of coal, is entirely wanting, the iron industry is but small, and makes little progress. Charcoal is almost exclusively used as fuel, and it is easily intelligible that the small output of mineral fuel will be of but little use to the iron industry. For this reason it has hitherto been more profitable to export the ores than to work them at home. The output of iron ores, as well as the quantities imported and exported, are given in the following table :—

| Year. | Production. | | Import. | | Export. | |
|---|---|---|---|---|---|---|
| | Metric Tons. | Value in £. | Metric Tons. | Value in £. | Metric Tons. | Value in £. |
| 1850 | 64,000 | 36,480 | ... | ... | ... | ... |
| 1860 | 71,000 | 39,420 | ... | ... | ... | ... |
| 1866 | 145,000 | 82,680 | 392 | 628 | 18,110 | 28,976 |
| 1867 | 105,000 | 59,880 | 6,578 | 10,524 | 31,562 | 50,500 |
| 1868 | 102,000 | 58,200 | 6,263 | 10,021 | 24,513 | 39,217 |
| 1869 | 101,000 | 57,600 | 1 | 2 | 54,122 | 86,594 |
| 1870 | 74,000 | 42,200 | 1 | 1 | 40,711 | 64,955 |
| 1871 | 72,000 | 41,040 | 7 | 3 | 45,322 | 18,129 |
| 1872 | 167,000 | 83,500 | 45 | 18 | 168,472 | 101,083 |
| 1873 | 260,000 | 132,720 | 431 | 172 | 151,949 | 97,169 |
| 1874 | 265,000 | 155,640 | 12 | 5 | 203,397 | 105,766 |
| 1875 | 234,000 | 134,000 | ... | ... | 191,157 | 76,463 |
| 1876 | 248,000 | 156,800 | 53 | 21 | 197,697 | 79,079 |

Iron ores are mined in the Lombardian provinces of Bergamo, Brescia, and Como, and in Sardinia and the Piedmontese provinces of Turin and Novara, but especially on the island of Elba, which produces by far the greatest part of the above quantity. The inexhaustible iron mountain on this island was known in the earliest ages, and mines were worked upon it by the Etruscans and Romans. The ore is shipped from the port of Rio, in the vicinity of which the most important mine of Verrucano is situated.

Since 1872 the production of iron ores has been rather high as compared with that of preceding years, and during the last two years the export amounted to one-fifth of the entire output. This export is principally to France, although some shipments are made direct to America.

As will be seen from the tables, the manufacture of pig-iron and castings, of wrought-iron, steel, and various other products, is only of little magnitude, owing to the want of fuel.

During the last ten years the average production of pig-iron has only been 20,000 to 25,000 metric tons per year. From 1866 to 1871 nearly twenty blast furnaces were at work, but since that time the number has decreased to about fourteen. Although good use has been made of these, the production of pig-iron has been nearly constant. It is only in one or two localities, particularly on the southern slopes of the Alps, in the districts of Bergamo and Brescia, and therefore unfavourably situated for an export trade, that the iron manufacture is carried on with activity. It is singular that the old Catalan method of the direct manufacture of steel and wrought-iron from the ore is still employed in these districts, and competes with the modern pig-iron manufacture.

| Year. | Pig-iron. | | | | | | Castings. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Production. | | Import. | | Export. | | Production. | | Import. | | Export. | |
| | Metric Tons. | Value in £. | Metric Tons. | Value in £. | Met. Tons. | Value in £. | Met. Tons. | Value in £. | Met. Tons. | Value in £. | Met. Tons. | Value in £. |
| 1866 | | | 14,593 | 75,883 | 1,963 | 10,207 | | | 5,655 | 99,735 | 171 | 3,411 |
| 1867 | | | 16,600 | 86,318 | 303 | 1,216 | | | 9,910 | 92,475 | 421 | 4,099 |
| 1868 | average | | 12,850 | 66,823 | 87 | 309 | | | 3,657 | 31,840 | 146 | 1,581 |
| 1869 | 22,200 | 100,000 | 20,386 | 106,010 | 127 | 507 | | | 3,848 | 34,876 | 80 | 883 |
| 1870 | | | 20,318 | 105,655 | 1,116 | 4,463 | | | 3,066 | 42,280 | 435 | 4,647 |
| 1871 | | | 18,932 | 98,446 | 1,680 | 6,720 | average | | 4,569 | 39,309 | 434 | 3,702 |
| 1872 | 26,000 | 133,200 | 21,874 | 131,244 | 3,722 | 26,798 | 4,600 | 36,000 | 6,229 | 98,986 | 439 | 7,232 |
| 1873 | 25,480 | 123,200 | 13,944 | 100,397 | 2,679 | 26,790 | | | 8,345 | 210,454 | 889 | 19,360 |
| 1874 | 21,054 | 107,800 | 30,186 | 181,116 | 868 | 6,249 | | | 7,767 | 185,323 | 710 | 16,528 |
| 1875 | 20,278 | 106,000 | 21,980 | 96,712 | 1,013 | 5,929 | | | 7,282 | 161,342 | 350 | 7,434 |
| 1876 | ? | ? | 22,535 | 81,126 | 744 | 3,693 | | | 5,352 | 114,879 | 313 | 6,973 |

| Year. | Steel. | | | | | | Rolled Iron | |
|---|---|---|---|---|---|---|---|---|
| | Production. | | Import. | | Export. | | Production | |
| | Metric Tons. | Value in £. | Metric Tons. | Value in £. | Metric Tons. | Value in £. | Metric Tons. | Va |
| 1860 ..... | ... | ... | ... | ... | ... | ... | 30,000 | 54( |
| 1866 ..... | | | 1,993 | 81,449 | 74 | 2,362 | 32,000 | 56( |
| 1867 ..... | aver | age | 2,216 | 89,498 | 227 | 9,418 | | |
| 1868 ..... | 650 | 13,000 | 2,270 | 76,025 | 140 | 4,700 | | |
| 1869 ..... | | | 2,370 | 79,653 | 116 | 3,576 | aver | age |
| 1870 ..... | 1,250 | 25,000 | 2,234 | 81,917 | 187 | 6,554 | 38,000 | 66( |
| 1871 ..... | 1,400 | 28,000 | 2,059 | 88,741 | 208 | 6,428 | | |
| 1872 ..... | 1,550 | 31,000 | 3,199 | 162,668 | 118 | 6,429 | | |
| 1873 ..... | 1,800 | 36,000 | 2,762 | 138,407 | 132 | 7,646 | | |
| 1874 ..... | 2,000 | 40,000 | 3,484 | 173,469 | 258 | 3,850 | 49,000 | 96( |
| 1875 ..... | 2,000 | 40,000 | 3,478 | 172,023 | 131 | 6,460 | | |
| 1876 ..... | 2,800 | 56,000 | 4,853 | 200,166 | 109 | 5,000 | | |

The above table shows the variable production of *steel*, and of the *produce of rolling-mills* (wrought-iron, blooms, sheet-iron, puddled bars, &c., exclusive of rails), as well as the import and export of steel rails.

It appears, from this table, that the average annual production of steel, has been about 2,500 metric tons during the last few years. As a rule this steel is of very good quality; but the import of steel is at present far greater than the production. These figures show further that the quantity of the different descriptions of wrought-iron made by the various ironworks, especially in Lombardy and Central Italy, has increased from 30,000 to 50,000 metric tons since the year 1860, and therefore has become considerably greater than the total home produce of pig-iron and castings. This is explained by the fact that the iron manufacturers mostly use English pig-iron, and that for some time many ironworks have been working up wrought scrap.

Finally, we give some figures concerning the *means of communication* of the country. The railway system has increased as follows. The length of Italian railways was:—

| | | |
|---|---|---|
| In 1840 ..... | 21 | kilometres. |
| „ 1850 ..... | 609 | „ |
| „ 1860 ..... | 2,189 | „ |
| „ 1866 ..... | 5,091 | „ |
| „ 1870 ..... | 6,183 | „ |
| „ 1873 ..... | 6,882 | „ |
| „ 1875 ..... | 7,675 | „ |
| „ 1877 ..... | 8,210 | „ |

The number of locomotives in the year 1876 amounted to 1,305, whereas in 1872 there were only 1,172.

The *inland navigation* during the year 1876 extended over a length of 3,016 kilometres of navigable rivers and canals. The state of the navy in 1876 was as follows: (1) Merchant navy, 142 steamers of 57,881 tons; 10,903 sailing vessels of 1,020,488 tons. (2) Men-of-war, 66 steamers of 147,345 tons.

| | Rolled Iron. | | | Iron and Steel Rails. | | | |
|---|---|---|---|---|---|---|---|
| | Import. | Export. | | Import. | | Export. | |
| | Value in £. | Metric Tons. | Value in £. | Metric Tons. | Value in £. | Metric Tons. | Value in £. |
| | ... | ... | ... | ... | ... | ... | ... |
| 3 | 909,013 | 4,629 | 94,208 | 19,102 | 137,535 | 88 | 628 |
| 6 | 1,102,682 | 7,596 | 171,343 | 22,525 | 198,217 | 5,513 | 48,513 |
| 2 | 1,053,670 | 5,203 | 97,542 | 15,452 | 135,974 | 1,215 | 10,694 |
| 8 | 1,322,050 | 3,421 | 61,549 | 13,642 | 120,053 | 1,887 | 16,604 |
| 4 | 1,190,490 | 2,990 | 72,984 | 31,149 | 274,111 | 4,050 | 35,643 |
| 2 | 1,124,569 | 1,805 | 35,958 | 22,521 | 198,185 | 7,383 | 64,970 |
| 8 | 1,297,824 | 3,792 | 56,524 | 23,409 | 327,726 | 768 | 6,784 |
| 0 | 1,372,234 | 4,122 | 110,393 | 29,037 | 406,578 | 2,937 | 25,882 |
| 0 | 1,516,976 | 5,273 | 113,035 | 57,566 | 805,784 | 8,303 | 113,582 |
| 9 | 1,429,315 | 2,629 | 48,058 | 52,062 | 624,743 | 295 | 3,540 |
| 3 | 1,194,650 | 1,845 | 32,310 | 40,227 | 321,818 | 87 | 696 |

# SWITZERLAND.

## 41,389·8 SQUARE KILOMETRES. 2,680,000 INHABITANTS.

SWITZERLAND is very scantily supplied with mineral fuel.

*Coal* is found in the cantons Valais, Zurich, Friburg, Berne, Vaud, and Thurgau. A publication issued by the Federal Statistical Office at Berne shows for each of the years 1870 and 1871 a total production of 17,367 metric tons, of a total value of £10,200. The total superficial area of the available coal measures is only 73·6 hectares, and the number of hands employed 180.

*Anthracite* was raised from three pits in Valais, during the same period, to the extent of 1,813 metric tons by thirty-six hands.

*Lignite* is found in the cantons Zurich, Vaud, St. Gall, and Friburg. According to the above-mentioned statistical publication the productive area is about 18·5 hectares; and 13 pits, employing 280 hands, produced a quantity amounting to 17,996 metric tons of this fuel during the year 1870.

Reports from Switzerland state that more recent statistical data are not available, and that Swiss coalmining has not made any material progress since 1870.

As a matter of course this small production is not sufficient for the domestic consumption of Switzerland, and still less for its industry, of which some branches are highly developed, although the numerous waterfalls offer a good substitute for steam power. The foundries and machine works of Switzerland especially, but also the other branches of metallurgical industry, are thus compelled to use a considerable quantity of foreign fuel to supplement their water power.

The *import* was:—

| | Coal. | Lignite, Coke, and Peat. |
|---|---|---|
| | 1876. | 1876. |
| | Metric Tons. | Metric Tons. |
| From France | 112,955 | 14,617 |
| „ Germany | 420,484 | 16,436 |
| „ Austria | 4,334 | 1,380 |
| „ Italy | 4,557 | 74 |
| Total in 1876 | 542,330 | 32,507 |
| „ 1875 | 465,195 | 26,177 |

The *export* of coal, lignite, coke, and peat (for the local consumption of the border districts) is shown by the following figures :—

| | | |
|---|---|---|
| To France | 2,609 | metric tons. |
| „ Germany | 871 | „ |
| „ Austria | 243 | „ |
| „ Italy | 186 | „ |
| Total in 1876 | 3,909 | „ |
| „ 1875 | 3,168 | „ |

The prices of mineral fuel in Switzerland are very high, owing to the cost of transport of foreign coal. The prices paid at the pit's mouth for ordinary coal were :—

| | 1870. | | | | | 1877. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | s. | d. | s. | d. | | s. | d. | s. | d. | |
| Coal, per metric ton | 9 | 7 | to 15 | 2 | ..... | 8 | 9¾ | to 17 | 7½ | |
| Anthracite „ | 6 | 4 | „ 15 | 10 | ..... | 7 | 2¾ | „ 20 | 9 | |
| Lignite „ | 1 | 4½ | „ 32 | 0 | ..... | 8 | 9¾ | „ 25 | 7¾ | |

The striking difference between the prices of coal and lignite is explained partly by the relatively better quality of some lignites, and partly by the difficulty in conveying the coal from some of the pits, in consequence of which the consumers prefer to use foreign coal, which is more easily obtainable. Some lignite pits, however, are situated in mountain valleys, where, owing to the difficulties of communication, the inhabitants are practically excluded from the supply of foreign coal, and consequently dependent upon the use of their own lignite, which in these cases is sold at a high price.

The prices of foreign coal by which the quotations for home produce are fixed, depend in Switzerland chiefly upon the question of transport, and in that respect the development of the railways and of the lake navigation deserves the fullest attention. The length of railways in Switzerland was :—

| | | | |
|---|---|---|---|
| 1860 | 962 kilometres. | 1869 | 1,336 kilometres. |
| 1862 | 1,132 „ | 1872 | 1,501 „ |
| 1865 | 1,295 „ | 1877 | 2,565 „ |

Besides the above there are on Swiss territory 64 kilometres of foreign railways. Recent statistical data concerning the navigation of the lakes are not at hand. The lakes have a total area of about 2,000 square kilometres, and carry about 90 steamers. The navigable length is nearly 800 kilometres, of which 140 belong to the Rhine and to the Lake of Constance.

## IRON.

*Iron ores* are found in the cantons Berne, Solothurn, Neufchâtel, Valais, and St. Gall, especially oolitic and red iron ore, and mostly of good quality.

The output of iron ores was :—

| Year. | Metric Tons. | Value in £. | Year. | Metric Tons. | Value in £. |
|---|---|---|---|---|---|
| 1847 | 14,959 | 8,046 | 1870 | 14,999 | 11,999 |
| 1850 | 16,571 | 8,834 | 1871 | 13,391 | 13,113 |
| 1855 | 28,984 | 19,311 | 1872 | 14,484 | 13,187 |
| 1860 | 21,020 | 16,816 | 1873 | 20,863 | 16,690 |
| 1866 | 21,826 | 17,461 | 1874 | 23,545 | 18,834 |
| 1867 | 17,676 | 14,141 | 1875 | 18,224 | 14,580 |
| 1868 | 18,656 | 14,917 | 1876 | 13,864 | 10,091 |
| 1869 | 15,845 | 12,676 | | | |

The output of ores might be considerably increased but for the want of the fuel necessary for their extraction. This circumstance has an important influence on the production of *pig-iron*, which during the last twenty years has greatly fluctuated without ever having exceeded the small quantity of 10,000 metric tons per annum.

The production of pig-iron was :—

| | | | |
|---|---|---|---|
| 1854..... | 7,000 metric tons. | 1870..... | 6,454 metric tons. |
| 1857..... | 9,000 „ | 1871..... | 6,654 „ |
| 1860..... | 7,111 „ | 1872..... | 6,987 „ |
| 1866..... | 8,218 „ | 1873..... | 8,470 „ |
| 1867..... | 5,836 „ | 1874..... | 9,979 „ |
| 1868..... | 6,518 „ | 1875..... | 7,379 „ |
| 1869..... | 6,518 „ | 1876..... | 6,334 „ |

The production of the rolling-mills is but little more important, and depends partly on working foreign iron. The production of all descriptions of *wrought and rolled iron* has been :—

| Year. | Metric Tons. | Value in £. | Year. | Metric Tons. | Value in £. |
|---|---|---|---|---|---|
| 1860 | 2,876 | 57,210 | 1871 | 3,908 | 62,528 |
| 1866 | 2,876 | 55,200 | 1872 | 4,043 | 70,922 |
| 1867 | 2,971 | 55,278 | 1873 | 4,828 | 86,904 |
| 1868 | 3,211 | 51,376 | 1874 | 5,170 | 92,660 |
| 1869 | 3,427 | 51,632 | 1875 | 5,504 | 92,467 |
| 1870 | 3,392 | 51,072 | 1876 | 6,116 | 87,856 |

On the other hand, the following branches of industry are very extensively developed in Switzerland, viz.: The manufacture of small arms, edge tools, machine tools, and watches. According to the returns of 1870 there were employed in these branches the following number of hands :—

| | Workpeople. | | |
|---|---|---|---|
| | Males. | Females. | Total. |
| Mechanics and Mathematical Instrument Makers | 6,119 | 29 | 6,148 |
| Ironfounders and Smelters | 1,443 | 2 | 1,445 |
| Forgemen and Plateworkers | 783 | 1 | 784 |
| Nailers and Wire-tack Makers | 1,101 | 6 | 1,107 |
| Gunsmiths and Armourers | 927 | 5 | 932 |
| Cutlers and Surgical Instrument Makers | 887 | 14 | 901 |
| File Cutters | 452 | 23 | 475 |
| Needle and Pin Makers | 104 | 10 | 114 |
| Watchmakers | 24,941 | 12,724 | 37,665 |
| Blacksmiths | 8,167 | 21 | 8,188 |

Switzerland is obliged to import large quantities of pig-iron and all kinds of wrought and rolled iron for home consumption, so that the import of the cheaper descriptions of iron manufactures is far in excess of the export. In 1877 there were even considerable quantities of pig-iron and rails exported, which, however, is to be attributed to the sale of large quantities of rails, &c., which were intended for the St. Gothard Railway, and which afterwards were not required. The following information is taken from official sources :—

| | Import. | | | Export. | | |
|---|---|---|---|---|---|---|
| | 1875. | 1876. | 1877. | 1875. | 1876. | 1877. |
| | Met. Tons. | Met. Tons. | Met. Tons. | Met. Tons | Met. Tons | Met. Tons |
| Pig-iron and raw steel | 29,363 | 31,069 | 20,279 | 3,191 | 2,817 | 4,402 |
| Forged and rolled bar-iron | 18,912 | 16,774 | 14,504 | 1,131 | 891 | 359 |
| Iron and steel rails iron sleepers | 44,426 | 16,724 | 11,487 | ..... | ..... | 3,838 |
| Plates (for engineering purposes) | 4,057 | 4,752 | 8,113 | | | 26 |
| Sheets (less than $\frac{1}{2}$ inch thick) | 2,682 | 3,004 | 2,855 | 97 | 98 | 40 |
| Galvanised sheets and tin-plate | 3,004 | 3,521 | 3,118 | | | 10 |
| Iron and steel wire | 1,128 | 1,260 | 1,177 | 48 | 32 | 15 |
| Iron castings | 7,928 | 7,580 | 5,662 | 590 | 563 | 452 |
| Common hardware (iron and steel) | 7,270 | 4,736 | 3,708 | 1,081 | 1,327 | 1,167 |
| Smallware (iron and steel) | 475 | 436 | 283 | | | 48 |
| Wrought-iron tubes | 1,904 | 1,906 | 1,829 | ..... | ..... | 253 |
| Engines and engine pieces | 10,424 | 7,662 | 4,681 | 9,477 | 9,425 | 11,836 |

The Swiss statistics of import and export take into account only the four neighbouring countries, Germany, Austria, Italy, and France, without showing how much of the supply is due to other countries. It is certain that England and Belgium have a great share in the import of all descriptions of iron into Switzerland.

According to the Belgian trade statistics, Switzerland imported from Belgium :—

| | 1875. | 1876. | 1877. |
|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. |
| Pig and Scrap Iron | 688 | 739 | 1,452 |
| Rails | 13,055 | 5,924 | 1,899 |
| Plates and Sheets | 2,196 | 2,147 | 1,659 |
| Forged and rolled Bar Iron | 6,273 | 4,568 | 3,041 |
| Hardware (wrought) | 605 | 744 | 225 |
| Hardware (cast) | 31 | 67 | 72 |
| Total | 22,848 | 14,180 | 8,348 |

# HOLLAND.

## 32,874·81 SQUARE KILOMETRES. 3,924,792 INHABITANTS.

If we consider the *Grand Duchy of Luxemburg* as being outside of the Dutch dominions—as in point of fact it is only connected with the kingdom of Holland by personal union, and as a former province of the German Empire it has continued to belong to the German Zollverein—we are scarcely justified in including Holland amongst the iron and coal producing countries at all, as this

country is so extremely poor in both *coal* and *iron* that the production is hardly worth mentioning.

*Coal* is found in the province of Limburg, as a continuation of the Belgian seams; the output, however, is utterly insignificant. The same applies to the iron ores of the provinces of Gelderland and Overyssel.

During the last ten years, however, the manufacture of *cast* and *wrought iron hardware*, of *cut* and *wire nails*, *arms*, &c., has gained a footing in Holland.

These industries, which have already commenced to export their productions, are based upon the use of English, Belgian, and German pig and bar iron, and amongst them the ironfoundries, which for the greatest part have been established at Amsterdam, Utrecht, Hertogenbosch, and Maestricht, have acquired a certain importance. Even in these respects, however, the import of Holland is as yet consideraly larger than the export. The exact quantities of coal and iron imported and exported do not appear among the figures of the official returns, the very considerable transit resulting from the commercial intercourse between England and Germany being comprised in them.

For a more detailed account of *Luxemburg* we beg to refer to our article on *Germany*. Here we may only mention that the Grand Duchy has an area of 2,587 square kilometres and 198,752 inhabitants, and that the following quantities of ores and pig-iron were produced there in the year 1875 :—

| | | | | | | |
|---|---|---|---|---|---|---|
| In 1866..... | 498,974 | metric tons of *ores*, | of a value of | ..... | £64,655 |
| „ 1867..... | 667,026 | „ | „ | „ | ..... | 80,574 |
| „ 1868..... | 722,059 | „ | „ | „ | ..... | 71,142 |
| „ 1869..... | 924,382 | „ | „ | „ | ..... | 119,270 |
| „ 1870..... | 911,695 | „ | „ | „ | ..... | 135,106 |
| „ 1871..... | 985,479 | „ | „ | „ | ..... | 131,961 |
| „ 1872..... | 1,170,939 | „ | „ | „ | ..... | 168,618 |
| „ 1873..... | 1,331,743 | „ | „ | „ | ..... | 188,597 |
| „ 1874..... | 1,442,666 | „ | „ | „ | ..... | 192,550 |
| „ 1875..... | 1,052,405 | „ | „ | „ | ..... | 143,270 |
| „ 1876..... | 1,196,000 | „ | „ | „ | ..... | 130,416 |
| In 1866..... | 46,460 | metric tons of *pig-iron*, | of a value of | ..... | £136,316 |
| „ 1867..... | 79,306 | „ | „ | „ | ..... | 202,680 |
| „ 1868..... | 105,408 | „ | „ | „ | ..... | 235,292 |
| „ 1869..... | 124,039 | „ | „ | „ | ..... | 329,322 |
| „ 1870..... | 129,440 | „ | „ | „ | ..... | 352,023 |
| „ 1871..... | 142,852 | „ | „ | „ | ..... | 392,437 |
| „ 1872..... | 180,549 | „ | „ | „ | ..... | 520,355 |
| „ 1873..... | 257,411 | „ | „ | „ | ..... | 1,165,585 |
| „ 1874..... | 246,054 | „ | „ | „ | ..... | 794,627 |
| „ 1875..... | 270,337 | „ | „ | „ | ..... | 876,464 |
| „ 1876..... | 231,658 | „ | „ | „ | ..... | ... |

During 1875 there were 21 blast-furnaces working and 8 out of blast.

Considering the small extent of the country this production is very considerable, being 1·35 metric tons per head. In this respect Luxemburg ranks first amongst the iron-producing countries of the world, the production per head being six times that of Great Britain.

Only a small portion of Luxemburg pig-iron is worked up within the country, by far the greater part being carried to the German provinces (see our article on Germany) and to Belgium. Its use in Luxemburg is confined to the production of a comparatively small quantity of *heavy castings* and *iron rails*, being 5,091 metric tons altogether in 1875, of a value of £51,647.

# DENMARK.

## 33,237 SQUARE KILOMETRES. 1,903,000 INHABITANTS.

As regards its possession of mineral fuel, Denmark is one of the poorest countries existing.

*Coal* is only found on the island of Bornholm, where an inferior description of it is raised from two mines belonging to a joint-stock company, the whole output being consumed on the island, chiefly by brick and other works owned by the same company. The quantity is insignificant, having formerly been from 6,000 to 7,500 metric tons, of which 3,000 were consumed at the above-named works, and this quantity has lately even decreased.

*Lignite* is found in several places in Jutland, as well as on the islands. It is, however, only raised in small quantities, just sufficient for the demand of the neighbourhood.

By far the greater portion of coal used in Denmark is supplied by import, the amount of which will be seen from the following table :—

| Year. | Import. | | Export. | |
|---|---|---|---|---|
| | Metric Tons. | Value in £. | Metric Tons. | Value in £. |
| 1866 | 355,815 | ..... | 40,567 | ..... |
| 1867 | 346,730 | ..... | 43,524 | ..... |
| 1868 | 411,204 | ..... | 35,348 | ..... |
| 1869 | 357,820 | ..... | 43,155 | ..... |
| 1870 | 433,060 | ..... | 49,852 | ..... |
| 1671 | 449,778 | ..... | 49,635 | ..... |
| 1872 | 430,520 | ..... | 45,355 | ..... |
| 1873 | 435,227 | 808,687 | 53,484 | 99,337 |
| 1874 | 470,040 | 650,543 | 57,158 | 79,444 |
| 1875 | 552,456 | 764,461 | 56,602 | 78,677 |
| 1876 | 583,075 | 717,256 | 49,644 | 61,339 |

*Iron* is not produced in Denmark. The following table contains the quantities of hardware made of iron and steel, of iron and steel for manufacturing purposes, and of pig and scrap iron imported and exported :—

| Year. | Import. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Import of Wrought Iron, Steel, and Hardware. | Steel. | | Bar-iron. | | Iron Rails. | | Pig Scr Iro |
| | Metric Tons. | Metric Tons. | Value in £. | Metric Tons. | Value in £. | Metric Tons. | Value in £. | Met To |
| 1866 | 22,405 | 502 | ..... | ..... | ..... | 874 | ..... | 10 |
| 1867 | 34,050 | 685 | ..... | 17,487 | ..... | 9,853 | ..... | 9 |
| 1868 | 28,598 | 744 | ..... | 18,731 | ..... | 3,479 | ..... | 9 |
| 1869 | 29,836 | 645 | ..... | 14,931 | ..... | 8,212 | ..... | 9 |
| 1870 | 30,613 | 658 | ..... | 16,657 | ..... | 5,682 | ..... | 10 |
| 1871 | 30,802 | 1,020 | ..... | 19,482 | ..... | 3,127 | ..... | 10 |
| 1872 | 35,813 | 805 | ..... | 19,392 | ..... | 7,781 | ..... | 9 |
| 1873 | 48,469 | 928 | 20,799 | 19,076 | 363,320 | 16,790 | 206,855 | 11 |
| 1874 | 51,827 | 1,091 | 19,419 | 23,956 | 370,326 | 11,967 | 146,377 | 14 |
| 1875 | 51,203 | 1,207 | 18,790 | 24,927 | 348,170 | 10,345 | 70,791 | 17 |
| 1876 | 48,720 | 1,323 | 22,064 | 26,176 | 357,769 | 7,065 | 39,283 | 19 |

Lastly, some particulars concerning the means of transport may be given. The mileage of Danish railways was :—

| Year. | Kilometres. | Year. | Kilometres. | Year. | Kilometres. |
|---|---|---|---|---|---|
| 1860 ..... | 79 | 1869 ..... | 669 | 1874 ..... | 1,037 |
| 1866 ..... | 474 | 1870 ..... | 763 | 1875 ..... | 1,250 |
| 1867 ..... | 474 | 1871 ..... | 869 | 1876 ..... | 1,250 |
| 1868 ..... | 588 | 1873 ..... | 869 | 1877 ..... | 1,466 |

Navigable rivers, canals, and lakes do not exist in Denmark. At the end of 1876 the mercantile fleet consisted of

180 steamers of ..... 43,720 tons,
3,083 sailing vessels of ..... 216,460 „

Being 3,263 vessels altogether, of which 3,144 belonged to Denmark proper, 119 to Iceland, the Faroe Islands, and the West Indian colonies.

ICELAND.—The native fuel of this island consists of peat and lignite. The only peat diggings are in a single bog near Reykjavik. Lignite is only found in the north-western extremity of the island, but is of such an inferior quality and insufficient quantity that only the nearest colonists are able to make use of it. No other mines exist on the island. The quantity of iron imported all the year round is 8,000, and that of coal 7,000 metric tons.

Export.

| tal Export of Wrought Iron, Steel, and Hardware. | Steel. | | Bar-iron. | | Iron Rails. | | Pig and Scrap Iron. |
|---|---|---|---|---|---|---|---|
| Metric Tons. | Metric Tons. | Value in £. | Metric Tons. | Value in £. | Metric Tons. | Value in £. | Metric Tons. |
| 2,313 | 72 | ..... | ..... | ..... | 294 | ..... | 625 |
| 2,650 | 125 | ..... | 1,010 | ..... | 902 | ..... | 2,382 |
| 2,540 | 129 | ..... | 982 | ..... | 219 | ..... | 3,429 |
| 2,055 | 91 | ..... | 900 | ..... | 332 | ..... | 2,079 |
| 2,027 | 82 | ..... | 1,076 | ..... | 40 | ..... | 2,518 |
| 3,220 | 283 | ..... | 1,967 | ..... | 80 | ..... | 3,816 |
| 5,530 | 124 | ..... | 2,495 | ..... | 65 | ..... | 6,560 |
| 4,393 | 115 | 2,584 | 2,541 | 47,944 | 490 | 6,033 | 3,102 |
| 4,772 | 171 | 3,044 | 2,427 | 39,639 | 173 | 2,115 | 4,358 |
| 6,115 | 283 | 5,042 | 2,367 | 34,785 | 1,833 | 12,542 | 2,443 |
| 5,262 | 190 | 3,484 | 2,740 | 38,346 | 361 | 2,004 | 4,626 |

# NORWAY.

## 316,694 SQUARE KILOMETRES. 1,802,882 INHABITANTS.

Coal is not raised within this country. It has been searched for at several places, as, for instance, at Jaderen, between Stavanger and Egersund, but the results have not been favourable, and the investigations have soon been discontinued. In 1876 some coal seams were discovered on the little island of Andö, on the western coast. They are said to be of moderate thickness only, but of easy access, and the quality of the coal is reported as fairly good. This discovery might accordingly be of some promise.

The country is obliged to satisfy its demand of coal by importation. The greatest portion of the coal imported comes from England, the total import amounting

In 1864 to 161,100 metric tons.
„ 1874 „ 275,000 „
„ 1875 „ 347,130 „

According to this the import of coal is visibly increasing.

The iron produced in Norway is of the very best quality. The quantity however is not large, the annual production being

about 6,250 metric tons of pig-iron.
„ 1,750 „ „ castings.
„ 4,000 „ „ wrought-iron.

All the iron is made by wood and charcoal only.

Owing to the ever-increasing price of wood, it is very difficult for the Norwegian ironworks to sustain the competition with the cheaper production of the foreign works. The number of ironworks in active operation is not as large now by far as it was in former times, and the greater portion of the output of ores is exported. The consequence of this is a considerable import of pig and wrought iron and of hardware.

The mileage of the railways was at the end of 1877 equal to 802 kilometres.

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# TURKEY.

## 532,728 SQUARE KILOMETRES. 15,140,000 INHABITANTS.

If a political and administrative reconstruction of the countries constituting the Turkish Empire could ever be achieved, great expectations might be entertained as to the rise of an extensive mining industry, which would be of great benefit to the inhabitants in affording them remunerative occupation and promoting general prosperity. Amongst the mineral deposits of these countries, which are considerable indeed, the coal seams and the beds of iron and copper ores are most conspicuous by their enormous contents and by the facilities they afford to mining enterprise.

As to the *coal* deposits, the only one in the whole Turkish Empire opened as yet is that of Eregli, on the Asiatic coast of the Euxine, between the Bosphorus and Ineboli. It has been worked by the Government for the last 20 years, but

the results have not borne out the expectations. Apart from this instance coal-mining does not exist in Turkey at present.

Here, however, it should be mentioned that a German company, which has been constituted for the purpose of carrying on mining operations in these unexplored regions, is at present endeavouring to work the coal seams of the island of *Imbros* by means of Styrian miners. As this island is not far out of the course of all vessels bound to or from the Sea of Marmora and the Euxine, this coal may possibly become of some importance, notwithstanding its inferiority in heating power when compared with English coal, which at present is monopolising the entire demand of the numerous steamers in the Bosphorus, the arsenals, and the other Government works, and is sold at Constantinople at £1 19s. 1d. to £2 4s. per metric ton, the price of the Imbros coal being 15s. 5d. per metric ton.

The quantity of English coal imported into Turkey amounted—

| | | | | | | |
|---|---|---|---|---|---|---|
| In 1875 | to | 247,361 | metric tons, | of a value of | ..... | £178,482 |
| „ 1876 | „ | 295,102 | „ | „ | ..... | 162,413 |
| „ 1877 | „ | 217,643 | „ | „ | ..... | 113,670 |

In *Macedonia* coal deposits have been proved to exist at many places. Thus, for instance, lignite seams of 0·5 metres thickness are cropping out at the surface in the vicinity of Köprülu and Usktib, in the dried-up watercourses of the lateral valleys of the Vadar river, and, according to the reports of the inhabitants of these parts, larger and more numerous deposits may be supposed to exist there. A mixture of this lignite and of English coal has been successfully tried as engine-fuel on the Salonica-Mitrovitza line. But as the disposition of the Government is indifferent, and that of the Mahometan inhabitants hostile to the utilisation of the mineral treasures of the country, mining operations have been out of the question up to the present.

In *Bosnia* extensive and thick seams of good lignite are known to exist, which, however, have hitherto been left out of consideration, owing to the abundance of forests.

*Servia*, too, possesses a large coalfield near to the village of Senje, in the district of Tchuprija, which is of the greatest importance for the future railway line Belgrad-Alexinatz-Nisch.

Coal is also found in the *Balkans*. New seams of it have quite recently been discovered during the Russo-Turkish war.

A great abundance of coal is possessed by Asiatic Turkey, as will be more particularly described under "Asia."

Of iron-ore beds *Bosnia* is prominently rich, and mining has been carried on there from time immemorial. But a great number of mines has been abandoned, and others are not worked efficiently, as the methods of mining as well as of iron-making have made no progress whatever for centuries. It is only surprising that both continue to be profitable in some degree. The ores contain nearly sixty per cent of iron, the actual return, however, owing to the primitive method of manufacture, being only ten to twelve per cent. The annual production of pig-iron amounts to from 5,000 to 6,000 tons. A circumstance which, apart from all political and social dissensions, will prove fatal to the feeble Bosnian mining industry is the increasing want of a proper fuel for the ironworks. The forests are being devastated in the most senseless manner, and nobody thinks of replanting. The forgemen are in the habit of cutting down the forest within their easiest reach around the forges, without minding the ever-increasing distance of their supply of charcoal. As there are no means of communication to speak of, there will be an end of this industry at no distant time, when competition will have become impossible in consequence of the high price of fuel.*

* Preseel, Die Situation der Türkei (manuscript).

The most important ironworks are situated near Starimaidan, and produce in 125 blooming furnaces a peculiar description of iron, which is worked up into arms and agricultural implements.

There are still some other places in Turkey where some pig and wrought iron is made, as, for instance, at Samakow, Raoutcha, Palanka, and at other places of the Balkans. The manufacture is carried on there in the same primitive way as in Bosnia and Servia. The annual production amounts at Samakow to about 12,000, and at Raoutcha to about 5,000 metric tons.

Generally speaking the iron industry of Turkey may be said to be as imperfectly developed as is imaginable. Almost the entire demand for iron is supplied from England, France, and Germany, and the import is not obstructed by the moderate rate of the import duty, which is 8 per cent *ad valorem*.

In *Roumania* neither coal nor iron ores are raised at present. Pit coal does not exist there, but lignite has been discovered at many places along the slope of the Carpathians. A deposit near Bachna, northward of Orsova, where 8 seams of 0·85 metre average thickness have been found, seems to be the most promising of all. The lignite contains 70·85 per cent of carbon. It has been tried as engine-fuel with perfect success. In February, 1878, Dr. NICOLAIDI began to raise a somewhat larger quantity (4,000 metric tons) of lignite on his estate at Marcascu, near Buzcu, which he offered to the Bucharest-Guirgewo line at 23s. 5d. per metric ton. This line makes use at present of the artificial fuel (*briquets*) manufactured by the Danube Steam Navigation Company, and this lignite would in all probability be introduced on all Roumanian lines if its price could be reduced a little.

A basin northward of Ploesti, belonging to the neogene strata, contains lignite of an inferior quality but in larger quantities.

The mileage of the railways opened to traffic was—

| | | In Turkey. | | In Roumania. | |
|---|---|---|---|---|---|
| In the year | 1860 | 66 | kilometres | — | kilometres. |
| " | 1870 | 286 | " | 245 | " |
| " | 1871 | 333 | " | 865 | " |
| " | 1872 | 805 | " | 939 | " |
| " | 1873 | 1,311 | " | 939 | " |
| " | 1875 | 1,537 | " | 1,233 | " |
| " | 1877 | 1,537 | " | 1,233 | " |

# GREECE.

## 50,123 SQUARE KILOMETRES. 1,457,894 INHABITANTS.

It has been known from ancient times that iron, lead, and copper are not wanting in Greece; but until recently mining operations have only been carried on to a very limited extent. Coal and iron ores are found in many places.

*Lignite* of an excellent description, and fit for smelting purposes, is found on the island of Eubœa, as well as on the eastern coast of Attica, near Corinth, and on the western coast of the Peloponnesus. Formerly an insignificant quantity only was raised in Eubœa and Attica, and lately also in the island of Antiparos. Some lignite mines in the proximity of Markopulo, a village in Attica, are worked by a Greek company. The output is preferred to the Kumi lignite (of

Eubœa), and is in fair demand for the factories of the Piræus and of Syra, as well as for the steamers of the Hellenic Company. The price per metric ton is 17s. 3d. at the pit's mouth, and 20s. at the Piræus. As the price of Newcastle coal at the latter place is 58s. 8d. per metric ton, this lignite may be used with profit, even if its heating power should only be half that of English coal.

Coal deposits also exist on the Ionian Islands.

The quantity of English coal and coke imported into Greece in 1875 was: 64,705 metric tons of coal, of a value of £50,046; and 18,367 metric tons of coke, of a value of £16,763.

*Iron ores* are found in such quantities on the little island of Seriphos that it might properly be called the Greek Elba. The beds of red, brown, and specular ores of this island have been extensively worked from ancient times. Owing to the insufficient appliances of those ages, however, the beds of magnetic ores have remained intact. But as the quantity raised in times gone by is utterly insignificant if compared to the bulk still available, these deposits are even now an object of great value. By extensive trials made in England the ores have been proved to be eminently suitable for Bessemer pig-iron. A Greek company commenced in 1870 to work these ores by means of Eubœan lignite.

Other beds of brown and red ores are found on the island of Andros, in several places of the Maina, in the vicinity of Cape Matapan, and on the islands of Thamia, Zea, and Eubœa. Bog ore is found near Corinth. In the province of Bœotia iron has been mined and worked from the most remote ages.

There existed in Greece in 1874 seven ironworks and one needle manufactory.

The only railway existing in Greece is that connecting Athens with the old seaport Piræus. It is 12 kilometres in length.

# AMERICA.

## UNITED STATES OF NORTH AMERICA.

### 9,333,680 SQUARE KILOMETRES. 38,925,598 INHABITANTS.

THE United States of North America, hitherto chiefly known as the abode of inventive mechanical genius, are now in consequence of the Centennial Exhibition of Philadelphia better appreciated in Europe as regards their mining resources too, and the success of their mining operations has been made so apparent that we should not be justified in making detailed statements from the exceedingly rich literature of recent date which describes the present state of mining enterprise in the States. We refer to this literature, equally excellent as to form and contents,* and confine ourselves to pointing out some important features characterising particularly the American coal and iron industry. We take particular notice of the coal trade, as an infallible test of national prosperity.

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* We mention and recommend as sources of our statistical information :—

THE AMERICAN IRON TRADE IN 1876, politically, historically, and statistically considered. By JAMES M. SWANK, Secretary of the American Iron and Steel Association. Annual report to January 1st, 1876. Philadelphia : The American Iron and Steel Association, No. 265, South Fourth Street, 1876.

THE IRONWORKS OF THE UNITED STATES. A Directory of the furnaces, rolling-mills, steelworks, forges and bloomeries in every State. Prepared by the American Iron and Steel Association, No. 265, South Fourth Street, Philadelphia. Centennial Edition, 1876.

STATISTICS OF THE AMERICAN AND FOREIGN IRON TRADES. Annual report of the Secretary of the American Iron and Steel Association, containing statistics of the American iron trade to January 1st, 1877, and a review of the present condition of the iron industry in foreign countries. Presented to the members, June 15th, 1877. Philadelphia: The Iron and Steel Association, No. 265, South Fourth Street, 1877.

Report on the Progress of the Iron and Steel Industries in Foreign Countries. By M. JULIEN DEBY, C.E., Brussels, in the *Journal of the Iron and Steel Institute*, 1877. London: E. A. T. N. Spon, 48, Charing Cross, p. 213, 599.

DIE WASSERSTRASSEN IN DEN VEREINIGTEN STAATEN VON AMERIKA, in ihrer commerciellen und industriellen Bedeutung. Im Auftrage Sr. Exc. des Ministers für Handel etc. verfasst von C. MOSLER. Mit 2 Farbendruck-Tafeln. Berlin : Ernst und Korn, 1877.

Further, the Publications of the Herren CHR. MOSLER, Salinendirector ; F. ALTHAUS, Oberbergrath, of Breslau ; Dr. H. WEDDING, geheimer Bergrath, of Breslau, on their official journeys to the Centennial Exhibition.

DIE INDUSTRIE AMERIKA'S (Vereinigte Staaten von Nord-Amerika), ihre Geschichte, Entwicklung und Lage, &c. By Dr. HERMANN GROTHE. Mit vielen Illustrationen, &c. Berlin, 1877. Verlag von Burmester and Stempell. Further :

Bericht über die Weltausstellung in Philadelphia, 1876. Herausgegeben von der Oesterreichischen Commission &c. IV. Heft : Das HÜTTENWESEN MIT BESONDERER BERÜCKSICHTIGUNG DES EISENHÜTTENWESENS in den Vereinigten Staaten Amerikas. Von FRANZ KUPELWIESER, Professor der Hüttenkunde, Director der K. K. Bergacademie in Leoben, ausw. Mitglied des American Institute of Mining Engineers, &c. Wien, Faesy und Frick, 1877.

## COAL.

Some data as to the situation, extent, and natural condition of the coal districts of North America will be given further on in the general statistical review.

It is a singular coincidence that the 100th degree of western longitude (from Paris) is an almost exact line of division between the proper coal measures, to which all deposits of the eastern States of the Union belong, and the coal of the cretaceous and tertiary systems, which is found only in the western States.

The area of the coalfields in the United States cannot be stated with exactitude, as the whole extent of the boundaries of the productive coal measures has not yet been accurately fixed, and as it is impossible to determine the exact workable area of them wherever they are covered by more recent formations.

Several statements as to the area of the coalfields have been made, most of them giving the total area occupied by the carboniferous system. Their figures are accordingly larger than the following, which refer only to the strata that, according to all appearances, are actually coal-bearing :—

| | | |
|---|---|---|
| 1. The anthracite district of New England... | 1,295 | square kilometres. |
| 2. The Pennsylvanian anthracites ..... | 1,217 | „ |
| 3. The Appalachian coalfield ..... | 152,804 | „ |
| 4. The Michigan coalfield ..... | 17,352 | „ |
| 5. The Central District ..... | 121,725 | „ |
| 6. The Missouri coalfield ..... | 202,012 | „ |
| Total ..... | 496,405 | square kilometres. |

According to this there is such an enormous quantity of first-rate coal of every description available for the manufacturing industry, that an extraordinary increase of the latter may safely be predicted, if the other influences by which it has hitherto been greatly promoted—American enterprise, low taxation, and cheap communication—continue to exist unimpaired.

The particular application of the produce of the coalmines depends upon the special quality in which it is found, whether as anthracite, bituminous coal, or as lignite. Among these three descriptions the coking coal of Pennsylvania takes the first place, as a rising iron industry is founded upon it, although the anthracite is likely to hold a nearly equal rank for a long time to come. By its nature coke is a more advantageous fuel for the blast-furnace than anthracite. The part to be played in future by the lump coal and the coking coal of the Southern States and of the Illinois district—especially of that portion of the latter extending to the banks of the Mississippi—cannot be anticipated at present. The great variety of coking coal makes a careful selection for the use of the blast-furnaces necessary. On the average this coal contains only about 4·7 per cent of ashes, but some descriptions contain as much as 5·3 and 5·5, and others even 19 per cent and more. The composition of the ashes is favourable, if the composition and admixtures of the ores are taken into account. The return of coke varies very much, but it is never below 50 per cent, and rarely above 70 per cent. The average percentage of carbon contained in the anthracite is 89 to 92 per cent. This description of coal, compared with bituminous coal, has the advantage of a greater hardness and cohesion, in consequence of which it is neither deteriorated by transport nor by exposure to the air. For working blast-furnaces the American anthracite is better adapted than the English, because it does not crack up in the fire like the latter.

The quantity of carbon contained in the bituminous descriptions of coal

varies in the different coal districts as much as from 40 to 78 per cent, while the percentage of ashes rises to 17 per cent, but sometimes falls to 2 per cent and lower. Apart from its great anthracite deposits, North America is not better provided with coal than any other of the principal coal-mining countries, nor is this the case as regards lignite and coal of the Trias or of the Jurassic formation. The latter two descriptions are however of no importance for the iron industry.

As to the number and disposition of places of production, our references, however excellent in other respects, give only scanty information. Accurate returns of the number of pits and hands employed are entirely wanting.

The *prime costs* are very low, because the shafts are as yet only sunk to moderate depths and are most extensively worked by machinery.

Some years ago the cost of production amounted scarcely to half a dollar (2s. 2d.), rarely to one dollar (4s. 3d.), per gross ton (2,240lb.); recently, however, it has increased in consequence of the general rise of prices and of wages, as well as of the insubordination and idleness of the workmen. The one-sided and selfish coalitions of the latter (resorting even to violence and crime), as well as frequent accidents and interruptions, have had a very prejudicial influence on the expense of coalmining. On a general average the costs of production are now coming up to nearly two dollars (8s. 7d.) per ton.

In spite of all this the costs of production would allow a comparatively high profit, owing to the high price of all descriptions of coal, if it were not reduced very considerably by the high costs of transport, by the different coalitions of coal masters competing with each other, and by the great fluctuation in the demand. Thus the price of anthracite fell from 7 dollars (£1 9s. 11d.) per gross ton in the year 1820 to 3·40 dollars (14s. 6d.) in the years 1860. It rose to 7·86 dollars (£1 13s. 8d.) until 1865, and fell again to 3·74 dollars (16s.) before the end of 1872. Certainly this is the lowest price of late years; but the prices are only nominal, and America, not less than other countries, is suffering from a depression of prices created by a coincidence of over-production and decreased demand.

The *development of the production*, as shown in the following chronologic-statistical review of the different States, has not originated in the anthracite districts, as usually supposed; coalmining began earlier in other different localities, although only to an extent sufficient for the local demand, the workings hardly deserving the name of mines. The statistical data respecting the output of anthracite, which are at our disposal, are contained in the table. As to the production of bituminous coal and of lignite we have no accurate returns, and all numerical statements on the subject are based on mere estimates. It is certain, however, that during the last year, for instance, the production has been so great that the market soon became overstocked, and that the balance between supply and demand was only restored by numerous strikes, which caused a partial emigration of the miners. Table I., page 173.

Besides coke, artificial fuel (*briquets*) is also made in North America, especially by the Anthracite Fuel Company at Rondout, New York. It is made from anthracite dust, which can be obtained on the spot at only 1½ dollars (6s. 5d.) per gross ton, and of 8 to 10% of tar, at the price of 10 dollars (£2 2s. 10d.) per ton. This product is sold at 4 dollars 50 cents to 5 dollars (19s. 3d. to £1 1s. 5d.) per ton, and is said to surpass in heating value the bituminous coal of North America (Cumberland coal) by 20% per cent.

The contribution* to the output of the last years by the several States and the principal coal districts is represented by the following figures. Table II., page 173.

* Hörns, Die Kohlen-und Eisenerz-Lagerstätten Nord-Americas. Vienna, 1873.

I.

| | The United States and Territories of North America. | Area. | Production in 1875. | | Means of Communication. | |
|---|---|---|---|---|---|---|
| | | | Coal. Lignite.* | Anthracite. | Railways. | Canals and Slack Waters. |
| | | Sq. Kilom. | Gross Tons of 1·016 Kg. | | Kilometres. | Kilometres. |
| 1 | Maine | 90,646 | 60,000 | ... | 1,588 | 81·27 |
| 2 | New Hampshire | 24,034 | ... | ... | 1,516 | 17·91 |
| 3 | Vermont | 26,448 | ... | ... | 1,304 | 1·71 |
| 4 | Massachusetts | 20,201 | ... | ... | 2,940 | 10·70 |
| 5 | Rhode Island | 3,382 | ... | 11,000 | 293 | ... |
| 6 | Connecticut | 12,302 | ... | ... | 1,488 | 8·85 |
| 7 | New York | 121,725 | ... | ... | 8,893 | 1,331·72 |
| 8 | New Jersey | 21,548 | ... | ... | 2,565 | 267·91 |
| 9 | Pennsylvania | 119,135 | 10,500,000 | 20,643,509 | 9,518 | 1,921,20 |
| 10 | Delaware | 5,491 | ... | ... | 459 | 20·33 |
| 11 | Maryland | 28,810 | 2,342,773 | ... | 1,757 | 369·34 |
| 12 | Virginia | 99,317 | 79,200* | ... | 2,652 | 347·58 |
| 13 | North Carolina | 131,318 | 100,000 | ... | 2,206 | |
| 14 | Georgia | 150,214 | | ... | 3,714 | 45·06 |
| 15 | Alabama | 131,365 | ... | ... | 2,771 | 83·30 |
| 16 | Texas | 710,553 | ... | ... | 3,335 | ... |
| 17 | Arkansas | 135,187 | 9,000 | ... | 1,267 | ... |
| 18 | Washington Terr. | 181,277 | 88,900* | ... | 177 | ... |
| 19 | West Virginia | 59,568 | 1,100,000 | ... | 927 | ... |
| 20 | Kentucky | 97,587 | 375,000 | ... | 2,356 | 1,236·76 |
| 21 | Tennessee | 118,099 | 360,000 | ... | 2,636 | 1,604·49 |
| 22 | Ohio | 103,503 | 4,346,653 | ... | 7,538 | 729·02 |
| 23 | Indiana | 87,562 | 800,000 | ... | 6,553 | 164·15 |
| 24 | Illinois | 143,506 | 3,500,000 | ... | 11,277 | 1·21 |
| 25 | Michigan | 146,202 | 12,000 | ... | 5,531 | ... |
| 26 | Wisconsin | 139,657 | ... | ... | 4,144 | ... |
| 27 | Missouri | 169,250 | 750,000 | ... | 4,854 | ... |
| 28 | Oregon | 246,750 | 28,800* | ... | 404 | ... |
| 29 | Utah | 218,784 | 35,000* | ... | 782 | ... |
| 30 | Minnesota | 216,337 | ... | ... | 3,257 | ... |
| 31 | Wyoming Territory | 253,507 | 278,000* | ... | 738 | ... |
| 32 | Nebraska | 196,819 | 1,300 | ... | 1,901 | ... |
| 33 | Iowa | 142,560 | 1,500,000 | ... | 6,336 | ... |
| 34 | Kansas | 210,605 | 275,000 | ... | 3,582 | ... |
| 35 | California | 489,441 | 166,100* | ... | 2,992 | ... |
| 36 | Colorado | 270,644 | 150,000* | ... | 1,526 | ... |
| 37 | Nevada | 269,673 | 1,000* | ... | 1,149 | ... |
| 38 | Remaining States | 2,066,614 | ... | ... | 6,396 | 140·93 |
| | Total | 7,659,621 | 26,031,726 | 20,654,509 | 123,322 | 8,383·44 |
| | | | 827,000* | | | |

II.

| Coal District of | 1870. | 1874. | 1875. |
|---|---|---|---|
| | Gross Tons. | Gross Tons. | Gross Tons. |
| Pennsylvania | 13,973,460 | 21,667,386 | 20,643,509 |
| The Appalachians | 11,548,580 | 18,700,239 | 18,800,259 |
| The Central Territory | 2,836,721 | 4,088,000 | 4,584,167 |
| Missouri | 821,233 | 2,470,300 | 2,535,300 |
| The more recent formations of the West | 69,771 | 725,900 | 747,800 |

According to this the anthracite district of Pennsylvania is the most important coalfield, next to which comes the Appalachian district, in regard to its geographical situation, as well as in respect of its yield. The conditions of production and of sale being for the greatest part identical for these two districts their outputs increased at an almost equal rate.

The New England, Michigan, and Virginia districts are only of secondary importance as regards the general demand. The large central and Missouri districts, which are situated in the very centre of the United States territory, exhibit a rapid increase of production, due, no doubt, to the immigration and the influx of capital and speculative enterprise into these parts. The same applies to the western coalfields, principally to those of the states of Wyoming, California, Colorado, and Washington.

All the numerous coalfields between the Missouri and the Pacific coast have been greatly benefited, and will become still more important by the completion of the Pacific line by which they are intersected, by the rapid advance of gold and silver mining, and the general progress following it its train.

Coal has also been discovered at several places in *Alaska* territory, which was transferred from Russia to the United States some time ago.

The *circulation* of the output of the various coal districts depends, as a matter of course, upon the places of consumption and the means of conveyance leading to them. The coal traffic on the numerous and good waterways is very brisk, and the railways by which the coal districts are connected with the centres of industry and commerce, especially of the iron industry, are carrying large quantities of coal. It is to be regretted that there are only partial returns of the coal traffic at hand, which do not enable us to obtain a more comprehensive view of it.*

Even the United States are in want of reliable information as to the amount of traffic on their water as well as railways. Excellent returns exist for certain districts only. As a rule much less coal is carried by water than by rail, a fact which is apparent also in other countries, and is not in favour of canals where they have to compete with railways. The Erie canal is almost the only one on which the coal traffic has increased. The lake steamers take a very important part in the coal traffic by water, especially in carrying coal as return freight, and screw steamers are running on the Chesapeake and Ohio canal with great success.† Nevertheless the coal carried by railway is estimated at not less than 500,000,000cwt. (of 50 kilos.), while the transport on canals scarcely reaches 250,000,000cwt. Both descriptions of traffic are greatly assisted by a very extensive system of *narrow gauge railways*, which have been and are now much more successful as *secondary* lines than the main roads of commerce, which, owing to the considerable costs of construction and of maintenance, are yielding only a small profit. The narrow gauge railways, with rails about 3 feet apart, had already reached an extent of 996 miles (1,603 kilometres) in the year 1874; in addition to which there has been completed or projected since that time a length of 8,714 miles (14,024 kilometres), so that the United States will shortly, if not presently, possess a *narrow gauge railway system of nearly* 10,000 *miles* (16,100 kilometres). A great part of these lines are owned by mines and works, but their length cannot be accurately stated from the information at our disposal.

The *demand* and the *state of the market* are subject to greater oscillations in

* One of the best papers which follow and report on the coal and iron trade of North America is a trade periodical appearing in New York, *The Coal and Iron Record.*

† Die Wasserstrassen in the Verein-Staaten von Amerika, &c. Von CHR. MOSLER. Berlin: Ernst und Korn. 1877.

North America than in other countries. Apart from the "rings" of mine owners which have hampered the free commercial intercourse, especially in the anthracite district, apart from the strikes and coalitions of workmen, there are other causes in North America which render the relation between supply and demand, or between the quantity in stock and that effectually wanted, far more uncertain than in other countries, viz., the great distance between the place of production and that of consumption, the spirit of enterprise which here and there baffles the calculations of producers and which is nowhere more uncertain than in the United States. The enormous fluctuation of prices in the various markets is a proof of this fact, which is also made apparent by the column of prices contained in the chronological table. The large *sales by auction* which are very frequent in America, are causing a depression of prices; but the establishment of a *coal exchange* appears to have a beneficial influence.

The rise in the market-price is increased by a *waste* of *slack* (coal-dust, dross, small coal), which is especially noticeable in the United States. It is not, as might be presumed, a consequence of negligence in screening the coal—America, on the contrary, being ahead of all other countries in this respect by the application of excellent machinery: it is the consciousness of possessing inexhaustible coal deposits which leaves the small coal as a worthless article on the pit bank, where it accumulates into enormous hills. At least one-third of the whole output of North American coal is said to be heaped up around the pits as useless rubbish, especially in the anthracite regions, its accumulation obstructing the regular mining operations and the removal of the coal. Such a considerable waste cannot fail to raise the market price, and to become a barrier to a rational and economical system of mining operations.

*Import and Export.*—The coal trade to or from foreign parts is still very limited in North America, as will be seen from the following statistical review:—

| Year. | Production. | | | | Import. | | Export. | |
|---|---|---|---|---|---|---|---|---|
| | Coal. | Anthracite. | Coal. | Anthracite. | Quantity in gross tons. | Value in £ sterling. | Quantity in gross tons. | Value in £ sterling. |
| | Gross tons of 1,016 Kilo. | | Average price per ton. | | | | | |
| | | | £ s. d. | £ s. d. | | | | |
| 1830 .... | 1,102,166 | 209,634 | .. | 1 5 7 | .. | .. | .. | .. |
| 1840 .... | 2,083,880 | 1,008,220 | .. | 1 0 11 | .. | .. | .. | .. |
| 1850 .... | 1,821,635 | 3,863,365 | .. | 0 15 7 | .. | .. | .. | .. |
| 1860 .... | 5,156,676 | 9,807,118 | 0 14 10 | 0 14 7 | 428,316 | 179,617 | 158,157 | 158,528 |
| 1866 .... | 7,764,007 | 14,092,837 | 1 5 5 | 1 4 10 | 437,179 | 187,113 | 224,085 | 239,771 |
| 1867 .... | 11,159,957 | 14,345,644 | 1 1 3 | 0 18 8 | 485,015 | 311,379 | 369,250 | 395,087 |
| 1868 .... | 12,447,845 | 15,810,466 | 1 0 6 | 0 16 6 | 390,982 | 252,340 | 281,250 | 319,816 |
| 1869 .... | 11,892,633 | 16,375,678 | 1 1 3 | 1 2 9 | 423,572 | 248,318 | 254,047 | 312,534 |
| 1870 .... | 17,648,468 | 17,819,700 | 1 0 2 | 0 18 9 | 456,959 | 247,567 | 267,432 | 303,178 |
| 1871 .... | 24,005,151 | 17,379,355 | 1 0 2 | 0 19 1 | 472,143 | 254,465 | 300,678 | 318,313 |
| 1872 .... | 23,332,521 | 22,084,083 | 0 19 11 | 0 16 0 | 459,898 | 296,616 | 502,851 | 524,036 |
| 1873 .... | 28,123,784 | 22,880,921 | 1 0 9 | 0 18 3 | 494,660 | 415,642 | 697,401 | 748,513 |
| 1874 .... | 25,248,684 | 21,667,386 | 0 19 10 | 0 19 6 | 498,028 | 428,104 | 763,402 | 697,523 |
| 1875 .... | *26,031,726 | 20,654,509 | 0 18 11 | 0 18 9 | 441,600 | 384,921 | 519,346 | 621,919 |
| 1876 .... | ? | 19,000,000 | 0 16 10 | 0 16 7 | 407,853 | 344,089 | 361,078 | 582,111 |

The great home demand does not allow of any considerable export, and England and the other countries which carry on an export coal trade will not have to fear American competition for a long time to come. The centres of consumption are sufficiently shown by our tables of the coal and iron returns of the various States. The iron trade, the manufactures of hardware and machinery included, consumes at least 60 per cent of the entire output of coal.

* Of lignite, 827,000 tons.

## IRON.

The United States represent the iron industry of the New World, or of the transatlantic countries, in opposition to the iron industry of Europe; and with regard to their abundance of coal and ores they may be said to be destined and entitled to export all descriptions of iron manufactures. From this point of view the enormous extent which has recently been attained by this industry cannot be considered as necessarily entailing over-production, although the demand has for the present lagged far behind the supply.

This, however, is different in the case of some branches of this industry, for which materials of a particular quality are requisite. If, for instance, America does not possess the necessary quantity of ores suitable for the Bessemer industry, the production of Bessemer steel on a large scale is, as a matter of course, out of the question.

The iron ores of high percentage, of which the United States, no doubt, possess a great quantity, contain too frequently a considerable quantity of *phosphorus*, which renders them unfit for steel making. There is also a want of ores containing a sufficient quantity of *manganese;* but most ores contain much silica, and therefore require a large quantity of limestone flux.

Unfavourable to a continuous and regular increase of the iron industry is also the great distance of the iron ores, especially of the richer and purer descriptions, from the large coal districts, a circumstance which increases the cost of production of all descriptions of iron in spite of all the good and cheap means of communication, the high percentage of ores, and the good quality of coal, and which, at the same time, is exposing the manufacture to all those accidents which inevitably accompany long transports by land and by water. Considering these circumstances the North Americans are always disposed to acquire and employ only the very best materials for their own use, and to reject the inferior descriptions as useless, without having any regard to the future wants and to the claims of posterity. This applies particularly to coal and iron ores, and the consequence is that the inferior descriptions are accumulating on the pit brow to mountains which already begin to render a free and speedy intercourse impossible.

There are *iron ores* in nearly *all* the States of North America, but they show great variations as to quality. A great part of the iron industry, especially of its most recent and important branch, the Bessemer works, relies on the ores of the state of *Michigan*, and of the ore district of *Lake Superior*. The output of these ores, which in 1856 was only 7,111 tons, amounted in the year 1866 to 296,972, in 1870 to 856,471, and in 1873 to 1,167,379 tons. Since then it has diminished twenty per cent in consequence of the decreasing production of iron, and in 1876 it amounted to 977,233 tons. Only a small quantity of these ores is smelted by charcoal or coke in the vicinity of the mines, the greatest part being carried to the centres of iron industry. The ore deposits extend as far as the state of Wisconsin. These ores are classified as follows: Red specular ores (hard solid hematite ores, the richest amongst them); black magnetic and slate ores; soft hematites; flag ores (a less rich description of the first group). The quantity of phosphorus and iron, the most important elements, may here be stated. The ores contain phosphorus from 0·031 to 0·224 per cent; iron from 49·19 to 66·51 per cent.

The price of ores in 1872 and 1873 was from 7 to 8 dollars (£1 9s. 11d. to £1 14s. 3d.) per gross ton, delivered at the wharf in the port of Marquette; but has fallen since that time to 4·5 and 5 dollars (19s. 3d. to £1 1s. 5d.) currency value. The costs of production amounted to from 2·70 to 3 dollars (11s. 7d. to 12s. 10d.), inclusive of carriage to Marquette, and to Chicago, Toledo, Cleveland, &c., from 1·5 to 1·70 dollars (6s. 5d. to 7s. 3d.) in addition, so that in the ports of the

southern shore the ores may be obtained for from 6 to 7 dollars (£1 5s. 8d. to £1 9s. 11d.)

*Magnetic ores* have been mined in the state of *New York*, on the western shore of Lake Champlain, since the year 1800. The production is stated at about 375,000 gross tons. The ores contain from 62 to 94 per cent of oxide and protoxide of iron, besides from 0·12 to 0·55 per cent of protoxide of manganese, and from 0·020 to 0·082 per cent of phosphorus. The price in the ports of Lake Champlain stands at 4 dollars (17s. 2d.)

*Pennsylvania* too has rich but not pure magnetic iron ores, containing more or less iron and copper pyrites. The quantity of iron contained in them is from 62 to 92 per cent, and the admixture of phosphorus is very small. Their price is low, in consequence of the cost of production being very moderate.

In the state of *Missouri* there are rich ores, but the production (about 370,000 tons), in comparison to the large quantity available, is very small. The same is the case in the state of *New Jersey* (production about 670,000 tons). The Missouri ores are of excellent quality, rich in iron and containing but little phosphorus. The sulphur is removed from them by calcining and washing. Manganese is almost entirely absent. The ores of New Jersey are not as good, but fit to supply a considerable local iron industry. Franklinites and zinc-work residues from the red zinc ores of this district are very valuable for the production of *spiegeleisen*, owing to the manganese they contain.

The state of *Ohio* possesses only poor ores, but in large quantities—very few hematites, but mostly blackband and clay ironstone. They are usually smelted together with ores from Missouri and Lake Superior for the purpose of making foundry pig-iron. Their percentage of iron varies between 30 and 70, and, as a matter of course, is still increased by calcination.

The principal deposits of *Tennessee* are magnetic ores of excellent quality, which yield a pig-iron of particular strength, which, for instance, is used for chilled railway wheels. The production however is but small. The ores contain manganese, only traces of phosphorus, and are also suitable for Bessemer iron.

*Kentucky* has a great abundance of limonites, clay ironstone, and blackband, also some red hematites, which are suitable for foundry and for high class forge pig-iron.

*West Virginia* is also rich in ores which contain only a small admixture of phosphorus, and are suitable for Bessemer iron.

*Alabama*, too, has rich deposits of hematites, which for their purity and contents of manganese may be used for producing spiegeleisen. This district promises well for the future, because the ores can be got at little cost, as for instance in the Red Mountains at 12 cents (6d.) per ton.

The United States have indeed many and large deposits of rich and good ores, but there is a want of ores which contain sufficient manganese and little phosphorus. Consequently *foreign* ores have to be resorted to, which are supplied in continually increasing quantities from *Algeria*, *Spain*, and *Canada*.

The total output of ores in the United States has recently been estimated as follows :—

1. Eastern *magnetic ore district*=1,300,000 tons, of which the Lake Champlain region supplies 330,000 ; New Jersey, 620,000 ; Cornwall, 250,000 ; other places, 100,000 tons.
2. Eastern *brown ore district*=300,000 tons.
3. Lake Superior region=1,000,000 tons.
4. Missouri region=330,000 tons.
5. Other ore regions=570,000 tons altogether.

These figures have been obtained under the supposition that the total production of pig-iron (2,220,000 tons) has been obtained from ores, containing on the average 60 %.*

This percentage however is, according to other detailed information, too high, and may be reduced by 15 to 20%. This would increase the total output of ores of the United States by two or three millions of tons. According to the official returns of 1850, 1,597,309 tons of ores have been used for producing 564,755 tons of pig-iron, from which a yield of only 35·36 % would result. For 1860 a consumption of 2,514,282 tons of ores for 884,474 tons of pig-iron has been returned, the percentage being only 35·18 %. Assuming that since that time the percentage has increased to 40 or 45 by improvements in dressing and melting, the 2,093,236 tons of pig-iron produced in 1876 would have required four or five million tons of ores instead of 3,700,000 tons as stated above.

## PRODUCTION.

The statistical returns of the *production of iron* by the various branches of the trade are duly registered in our tables. Our limited space forbids us to offer further remarks on this subject, which has been most exhaustively treated in numerous recent publications, to which we beg to refer our readers.

The first beginning of this industry may however be mentioned in a few words. The first ironworks, which were established in the year 1620 at Falling Creek, went to ruin in the following year, because the Indians killed all the workmen. In the year 1643 new works were erected at Lynn, in the state of Massachusetts, and here the first piece of hardware, a small cooking vessel holding about two pints, is said to have been made. After this, new ironworks were started at short intervals at Newhaven, Rhode Island, New Jersey, &c. In the year 1750 the state of Massachusetts contained 3 forges and 1 blast-furnace. The Oxford furnace dating from that time is said to be the oldest existing in the United States; but the furnace and foundry erected in 1735 by Samuel Waldo in Rhode Island were the most important among the ironworks of the past century. The production of hardware was carried on until the last quarter of the past century in a rather primitive fashion; as an instance we may mention that during the long winter evenings, when all other work had ceased, a smithy fire was improvised in a corner of the fire-grate, on which children made nails from bar-iron. At the time of the war of secession, however, the iron industry made a great forward stride, which may easily be accounted for by the demand for cannon, shot, and other war material, by which numerous works were fully occupied, and the entire cessation of import from Europe, the result being an extraordinary increase in the demand for hardware for private use and the erection of new ironworks. To give an idea of the rapid progress of the iron industry at that time, we may mention, for instance, that in Rutland—where the first mine had been open since 1785—fourteen ironworks, three blast-furnaces, and a slitting mill were already at work in 1794. In the year 1790 one rolling and one slitting mill existed at Boston, and in 1792 one rolling mill at Dover. Until the year 1800 the number of establishments had increased to 3 rolling and slitting mills, 2 blast-furnaces, and 40 ironworks. Two of the latter were working with four fires each. Even in Pennsylvania, where the native iron industry had decidedly lagged behind that of the other States, 14 blast-furnaces and 34 ironworks were at work as early as 1789.

The present extent of the ironworks is shown by the following table, and also the table on pages 180 and 181 :—

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*See Dr. WEDDING, Das Eisenhüttenwesen der Ver. Staaten von Nord-Amerika in the "Zeitschrift für Berg-, Hütten- und Salinenwesen, &c." 1876, II. p. 349.

PRODUCTION OF BLAST-FURNACES IN 1876.

| The United States and Territories of North America. | Furnaces, 1875. | | Production in 1876. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Anthracite Furnaces. | | | Coal and Coke Furnaces. | | | Charcoal Furnaces. | | | Total Production Net Tons. |
| | No. | Capacity. | In blast | Out of blast | Production | In blast | Out of blast | Production | In blast | Out of blast | Production | |
| | | Net tons = 2,000lb. = 907·2 Kilogrammes. | End of 1876. | | Net Tons. | End of 1876. | | Net Tons. | End of 1876. | | Net Tons. | |
| Maine | 1 | 5,700 | .. | .. | .. | .. | .. | .. | 1 | .. | 3,002 | 3,002 |
| Vermont | 2 | 7,000 | .. | .. | .. | .. | .. | .. | .. | 2 | 550 | 550 |
| Massachusetts | 6 | 25,250 | .. | 1 | .. | .. | .. | .. | 1 | 4 | 5,040 | 5,040 |
| Connecticut | 10 | 35,000 | .. | .. | .. | .. | .. | .. | 4 | 6 | 10,160 | 10,160 |
| New York | 57 | 529,500 | 18 | 23 | 173,535 | .. | .. | .. | 5 | 11 | 8,085 | 181,620 |
| New Jersey | 18 | 183,600 | 4 | 14 | 25,349 | .. | .. | .. | .. | .. | .. | 25,349 |
| Pennsylvania | 279 | 2,264,900 | 62 | 102 | 588,829 | 35 | 41 | 397,685 | 16 | 23 | 23,099 | 1,009,613 |
| Maryland | 24 | 98,700 | 1 | 2 | 6,013 | .. | 6 | .. | 4 | 11 | 13,863 | 19,876 |
| Virginia | 34 | 72,400 | .. | 1 | 852 | 1 | 4 | 4,844 | 5 | 22 | 7,350 | 13,046 |
| North Carolina | 8 | 17,500 | .. | .. | .. | .. | 1 | .. | .. | 7 | 400 | 400 |
| Georgia | 12 | 43,400 | .. | .. | .. | 1 | 2 | 10,018 | 1 | 7 | 500 | 10,518 |
| Alabama | 14 | 83,000 | .. | .. | .. | 1 | 1 | 1,415 | 4 | 7 | 23,317 | 24,732 |
| Texas | 1 | 1,500 | .. | .. | .. | .. | .. | .. | .. | 1 | 426 | 426 |
| West Virginia | 12 | 99,400 | .. | .. | .. | 1 | 5 | 40,865 | .. | 6 | 300 | 41,165 |
| Kentucky | 23 | 138,300 | .. | .. | .. | 2 | 2 | 17,472 | 2 | 17 | 17,214 | 34,686 |
| Tennessee | 22 | 99,400 | .. | .. | .. | 2 | 2 | 14,517 | 3 | 17 | 10,068 | 24,585 |
| Ohio | 99 | 863,320 | .. | .. | .. | 27 | 36 | 354,346 | 11 | 26 | 48,931 | 403,277 |
| Indiana | 9 | 71,500 | .. | .. | .. | 2 | 6 | 12,869 | 1 | .. | 1,678 | 14,547 |
| Illinois | 12 | 188,000 | .. | .. | .. | 3 | 9 | 54,168 | .. | .. | .. | 54,168 |
| Michigan | 34 | 268,160 | .. | .. | .. | 1 | 3 | 12,700 | 6 | 24 | 82,477 | 95,177 |
| Wisconsin | 14 | 109,700 | .. | .. | .. | .. | 3 | 25,000 | 5 | 6 | 26,261 | 51,261 |
| Missouri | 19 | 223,500 | .. | .. | .. | 2 | 6 | 44,110 | 4 | 7 | 24,113 | 68,223 |
| Oregon | 1 | 4,000 | .. | .. | .. | .. | .. | .. | .. | 1 | 1,750 | 1,750 |
| Utah | 1 | 1,500 | .. | .. | .. | .. | 1 | .. | .. | 1 | 65 | 65 |
| Minnesota | 1 | 5,000 | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. |
| Total | 713 | 5,439,230 | 85 | 143 | 794,578 | 78 | 128 | 990,009 | 73 | 207 | 308,649 | 2,093,236 |

The increase of the production and the imported and exported quantities of the different descriptions of iron will be gleaned from the following table :—

| Year. | Production. | | | | | Import. | | | | Export. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pig-iron. | Bar, &c., Iron. | Steel, excl. of Rails. | Iron Rails. | Steel Rails. | Pig-iron. | Bar, &c., Iron. | Iron Rails. | Steel Rails. | Pig-iron. | Bar, &c., Iron. | Steel. | Iron Rails |
| | Net Tons | Net T. | Net T. | Net T. | Net T. | Net T. | Net T. | Net T. | Net T. | Net T. | Net T. | N.T. | N. T. |
| 1800 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 213 | 595 | .. | .. |
| 1810 | 60,480 | .. | .. | .. | .. | .. | .. | .. | .. | 104 | 667 | .. | .. |
| 1820 | 22,400 | .. | .. | .. | .. | .. | .. | .. | .. | .. | ? | .. | .. |
| 1830 | 184,800 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1840 | 352,800 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1850 | 652,526 | 278,044 | .. | 44,083 | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1860 | 919,770 | 406,298 | .. | 205,038 | .. | 80,078 | 193,236 | 136,836 | .. | .. | .. | .. | .. |
| 1866 | 1,350,343 | 595,311 | 18,973 | 430,778 | .. | 114,669 | 89,517 | 87,368 | .. | .. | .. | .. | .. |
| 1867 | 1,461,626 | 579,838 | 19,000 | 459,558 | 2,550 | 125,487 | 113,964 | 118,825 | .. | .. | .. | ? | .. |
| 1868 | 1,603,000 | 598,286 | 21,500 | 499,489 | 7,225 | 125,589 | 103,442 | 169,257 | .. | .. | .. | .. | .. |
| 1869 | 1,916,641 | 642,420 | 23,000 | 583,936 | 9,650 | 153,400 | 115,126 | 206,227 | .. | .. | .. | .. | .. |
| 1870 | 1,865,000 | 705,000 | 35,000 | 586,000 | 34,000 | 171,679 | 100,094 | 309,217 | .. | .. | .. | .. | .. |
| 1871 | 1,911,608 | 710,000 | 37,000 | 737,483 | 38,250 | 199,515 | 126,235 | 513,022 | .. | 3,967 | 2,778 | 8 | 246 |
| 1872 | 2,854,558 | 941,992 | 40,000 | 905,930 | 94,070 | 277,282 | 145,824 | 472,365 | 122,955 | 2,269 | 2,458 | 33 | 96 |
| 1873 | 2,868,278 | 1,076,368 | 52,000 | 734,685 | 155,392 | 241,355 | 107,233 | 240,504 | 160,041 | 3,154 | 3,450 | 9 | 1,416 |
| 1874 | 2,689,413 | 1,110,147 | 49,681 | 567,588 | 161,825 | 103,036 | 44,982 | 20,379 | 146,410 | 10,798 | 6,421 | 338 | 4,382 |
| 1875 | 2,266,581 | 1,097,867 | 61,058 | 482,213 | 310,299 | 59,849 | 32,400 | 2,198 | 44,934 | 17,681 | 11,722 | 64 | 1,959 |
| 1876 | 2,093,236 | 1,042,101 | 71,088 | 454,377 | 425,252 | 88,990 | 34,605 | 296 | 4,977 | 7,607 | 14,627 | 67 | 1,122 |

| The United States and Territories of North America. | PRODUCTION OF ROLLING | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Bar and other Iron | | | |
| | No. of Works. | No. of Puddling Furnaces. | Total Capacity of Works (inclusive of Rails). Net Tons of 907·2 kil. | Bar, Angle, Bolt, Rod, Hoop, Plate, and Sheet Iron | Cut Nails and Spikes. | Capacity of Rail Mills. | Total Production of Rails. |
| | | | | Net Tons. | Net Tons. | Net Tons. | Net Tons. |
| Maine | 2 | 26 | 25,000 | 3,314 | ... | 15,000 | 7,500 |
| New Hampshire | 1 | ... | 6,000 | 1,900 | ... | ... | ... |
| Vermont | 1 | 14 | 20,000 | ... | ... | 20,000 | 9,183 |
| Massachusetts | 22 | 173 | 179,100 | 47,183 | 22,332 | 40,000 | 9,061 |
| Rhode Island | 2 | 12 | 17,200 | 6,900 | 494 | ... | ... |
| Connecticut | 7 | 14 | 22,900 | 10,114 | ... | ... | ... |
| New York | 23 | 309 | 360,400 | 69,821 | 3,580 | 169,000 | 57,306 |
| New Jersey | 16 | 172 | 141,300 | 35,048 | 17,120 | 15,000 | 243 |
| Pennsylvania | 137 | 2,153 | 1,624,500 | 401,926 | 68,409 | 684,500 | 353,925 |
| Delaware | 8 | 34 | 30,000 | 17,598 | ... | ... | ... |
| Maryland | 5 | 99 | 91,500 | 12,337 | ... | 58,000 | 18,844 |
| Virginia | 4 | 46 | 48,460 | 11,334 | 5,972 | ... | ... |
| Georgia | 2 | 13 | 23,500 | 2,251 | 750 | 15,000 | 9,000 |
| Alabama | 1 | 4 | 1,000 | 1,000 | ... | ... | ... |
| West Virginia | 8 | 181 | 114,500 | 3,651 | 45,447 | 25,000 | 538 |
| Kentucky | 10 | 160 | 104,000 | 24,391 | 4,959 | 15,000 | 1,524 |
| Tennessee | 4 | 31 | 41,400 | 1,450 | 430 | 28,000 | 21,394 |
| Ohio | 46 | 669 | 634,600 | 119,857 | 28,672 | 292,000 | 100,799 |
| Indiana | 10 | 129 | 100,600 | 16,164 | 9,715 | 71,000 | 29,383 |
| Illinois | 9 | 98 | 323,000 | 9,921 | 10 | 305,000 | 181,490 |
| Michigan | 3 | 31 | 32,000 | 3,725 | ... | 18,000 | 1,600 |
| Wisconsin | 1 | 34 | 60,800 | 8,700 | ... | 44,800 | 21,280 |
| Missouri | 6 | 68 | 94,000 | 18,790 | ... | 50,000 | 20,903 |
| Wyoming Territory | 1 | ... | 15,000 | ... | ... | 15,000 | 12,320 |
| Kansas | 2 | ... | 45,000 | ... | ... | 45,000 | 14,707 |
| California | 1 | 5 | 25,000 | 6,836 | ... | 15,000 | 8,629 |
| United States, Total | 332 | 4,475 | 4,180,760 | 834,211 | 207,890 | 1,940,300 | 879,629 |

The extent of the export of cast-iron hardware does not appear from the preceding table, because the trade reports only mention its value. The export amounted—

In 1875 to ..... 512,185 dols. = £109,608.
„ 1876 „ ..... 397,982 „ = 85,168.

The import of cast-iron hardware is quite insignificant, and has been continually decreasing during the last years.

The prices during the year 1877 were as follows :—

For pig-iron delivered at Philadelphia..... 18 dols. (£3 17s. 0d.)
„ rolled bars ditto ditto ..... 44·80 „ (£9 11s. 8d.)
„ steel rails at the works ..... 40·50 „ (£8 13s. 4d.)
„ iron rails ditto ..... 32·54 „ (£6 19s. 2d.)

In comparing these prices with those of former years, we perceive that the complaints of a gradual decline of the iron trade, of low wages, small profits or none at all, bankruptcies, and general discouragement of the American iron

| MILLS IN 1876. and Iron and Steel Rails. Iron and Steel Rails. | | | | | | | Production of Steel (Bessemer Steel excluded). | | Production of | |
|---|---|---|---|---|---|---|---|---|---|---|
| Of this, Heavy Iron and Bessemer Rails. | Bessemer Works. | | | Steel (excl. Bessemer) and Composite Rails. | Tramway Rails. | | Crucible Steel. | Puddled, German and Blister Steel. | Bloom-eries. | Catalan Forges. |
| | No. of Works. | No. of Con-verters. | Capacity of Converters | | Total. | Of Bessemer Steel. | | | | |
| Net Tons. | | | Net Tons. | Net Tons. | Net T. | Net Tons. | Net Tons. | Net Tons. | Net Tons. | Net. T. |
| 7,500 | ... | ... | ... | ... | ... | ... | | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... | | ... | ... | ... |
| 9,183 | ... | ... | ... | ... | ... | ... | 1,098 | 6,985 | ... | ... |
| 9,061 | ... | ... | ... | ... | ... | ... | | | ... | ... |
| ... | ... | ... | ... | ... | ... | ... | | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... | | ... | ... | ... |
| 44,615 | 1 | 8 | 11·5 | 12,691 | ... | ... | 2,300 | 139 | 20,784 | ... |
| 57 | ... | ... | ... | .. | 186 | ... | 6,806 | 652 | ... | ... |
| 343,740 | 5 | 10 | 50 | 100 | 10,085 | 3,563 | 28,217 | 15,148 | ... | 23,844 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 18,844 | ... | ... | ... | ... | ... | ... | 261 | Tennessee | ... | ... |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 9,000 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 538 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 960 | ... | ... | ... | ... | 564 | ... | ... | ... | ... | ... |
| 21,347 | ... | ... | ... | ... | 47 | ... | Maryland | 214 | ... | ... |
| 99,828 | 1 | 4 | 20 | ... | 971 | ... | 700 | 9,558 | ... | ... |
| 29,285 | ... | ... | ... | ... | 98 | ... | ... | ... | ... | ... |
| 181,074 | 3 | 6 | 30 | ... | 416 | ... | ... | ... | ... | ... |
| 1,600 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 21,280 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 20,360 | 1 | 2 | 10 | ... | 534 | ... | ... | ... | ... | ... |
| 12,320 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 14,707 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 8,453 | ... | ... | ... | ... | 176 | ... | ... | ... | ... | ... |
| 853,752 | 11 | 25 | 121·5 | 12,791 | 13,068 | 3,563 | 39,382 | 31,796 | 20,784 | 23,844 |

manufacturers and workmen, are only too well founded. As a proof, we may mention that the price of—

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pig-iron | was in | 1861.. | 18·92 | dols. | (£4 0s. 11d.), | present price | being | 18 | dols. (£3 17s. 0d.) |
| Bar-iron | „ | 1852.. | 52·50 | „ | (£11 6s. 6d.), | „ | „ | 44·80 | „ (£9 11s. 8d.) |
| Steel rails | „ | 1868..165·0 | | „ | (£35 6s. 2d.), | „ | „ | 40·50 | „ (£8 13s. 4d.) |
| Iron rails | „ | 1862.. | 36·50 | „ | (£7 16s. 2d.), | „ | „ | 32·54 | „ (£6 19s. 2d.) |

These are figures which need no comment.

The existence and development of the North American iron industry is based more upon *technical* and *mechanical* conditions and upon the *commercial policy* of the States than upon mineral wealth and *natural* advantages. Two circumstances especially must be considered as impediments which it will be hard to remove: first, the deficiency of ores containing the necessary proportion of manganese, and sufficiently free from phosphorus at the same time; and, secondly, the absence of that fortunate proximity of ores and coal which is acting so beneficially in England and Scotland, and by which the latter are able to challenge and to restrict the competition of any foreign country.

In spite of all their mineral wealth, of all the progress of technical and chemical science, of all their perfect working arrangements and labour-saving appliances, the United States ironworks will only be able to hold their own and to advance, as long as they have the benefit of their well-tried and efficient *protective tariffs*, and as long as their owners will be able to go hand in hand with the *railway* and *canal companies*, and to keep the prime costs of manufacture down to a proper level by their assistance.

This much is certain, that the railway tariffs have a powerful influence on the advance of the American iron industry. The iron trade had suffered a long time from a system of high and arbitrary tariffs until the breakdown of the wholesale swindling operations carried on by the railway companies compelled the Legislature to interfere, and to subject the system of railway tariffs to a legal control. Of the entire mileage of the United States railways (being 132,322 kilometres in 1875, and 128,187 kilometres at the end of 1877) a portion of 12,500 kilometres, representing 84 lines, and an outlay of 417,000,000 dollars (£89,000,000) have been brought to a forced sale, resulting in some cases in the loss of the whole capital, and in most cases of more than 50 per cent of it. Sixty other lines, with a capital of 575,000,000 dollars (£123,000,000) will yet be offered for sale. It is now certain that a better administration, subject to Government control, will take the interests of the parties concerned into consideration, and that it will pay a due regard especially to the iron trade by introducing cheaper rates of freight.

In some few cases only the ore and coal mines and the ironworks are in the hands of the same owners. The division of labour, and with it the division of profit and the diversity of interests have accordingly been imposed beforehand upon the iron industry of the United States by the force of *natural circumstances*. But the prime costs are certainly not reduced by it, and are sufficiently high to make an *overpowering* competition on any iron market of Europe impossible. The iron trade of the States has, however, not yet attained its greatest extent. Other States and territories, which are in full possession of the conditions of a prosperous iron industry, may be added to the present iron-producing districts; but the export to foreign parts will always be obstructed by the impediments just mentioned and a flooding of the European iron markets—a prophecy made some time ago in England, Belgium, and Germany, and due no doubt to the efforts and successes of the American ironmasters—is not to be feared as long as iron making is carried on in America under the conditions existing at present. But even the beginnings of this competition should not be undervalued in its bearing upon the possibility for the future, and we conclude, therefore, with the cautious remark of KUPELWIESER: "Henceforth the development of the North American iron industry should not by any means be left out of sight or undervalued by Europe."

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NOTE.—According to the last report of the Iron and Steel Association, which has been published in the meanwhile, the total production of pig-iron in the United States amounted in 1877 to 2,314,585 tons (2,351,618 metric tons), exceeding that of the previous year by 221,429 tons (224,972 metric tons), the stock having at the same time decreased from 686,798 tons (697,787 metric tons) at the end of 1876, and to 642,357 tons (652,629 metric tons) at the end of 1877. According to this the consumption in 1877 had increased by 265,846 tons (270,099 metric tons) against that of the previous year. Almost the whole production consisted of Bessemer pig-iron.

The quantity of rails produced in 1877 was 764,709 tons (776,944 metric tons), viz.: 332,540 tons (337,860 metric tons) of iron rails, and 432,169 tons (439,084 metric tons) of steel rails—the total production in 1876 being 879,629 tons (893,703 metric tons), consisting of 467,168 tons (474,643 metric tons) of iron rails, and of 412,461 tons (419,060 metric tons) of steel rails.

# DOMINION OF CANADA.

## 9,203,255 SQUARE KILOMETRES. 3,833,502 INHABITANTS.

THE *coalfields* of *Canada proper* are situated on the eastern shore of the southern portion of Canada. Their total area is 5,700 square kilometres, which are comprised in the name of the "Acadian coal district." According to local circumstances the whole is divided into three basins, that of New Brunswick, Nova Scotia, and Cape Breton.

The *New Brunswick* basin is not of any importance. The seams, of which there is a great number, are very extensive and entirely horizontal; but they are generally only a few inches thick, and some workings of an insignificant character have only been commenced in one single locality.

In *Nova Scotia* several seams of bituminous coal are known, but here, too, the greatest part of them are not paying, in consequence of the considerable admixture of shale and ashes. Only two seams are being worked, having a thickness of 7·2 and 3·6 metres of workable and fairly good coal.

The greatest portion of Nova Scotia coal is raised in Picton county, where the Albion Mine ranks first, with an output of 130,069 metric tons and 607 hands for 1875. Some analyses of picked samples of coal gave the following results :—

| | Upper Seam. | Lower Seam. |
|---|---|---|
| Carbon | 66·50% | 68·50% |
| Gases | 24·28 „ | 20·46 „ |
| Water | 1·48 „ | 2·54 „ |
| Ashes | 7·74 „ | 8·50 „ |

Generally, however, the percentage of carbon is less, and ashes have been found up to 14 per cent. Owing to this the coal is not worth a lengthy transport, and even if it were admitted in the United States duty free it would not be able to compete in the Atlantic ports with other bituminous coal of better quality and of equal price. Most of the Nova Scotia coal is sold as steam coal; a few mines are yielding close-burning coal, which, however, is never used for coking purposes.

The third coal basin is situated near *Cape Breton* and Sydney Harbour, on the north-western point of the Nova Scotia peninsula. Its superficial extent is less than each of the two before-named basins, but the quality of the coal is far superior. Of the great number of seams only two are worked, being of a thickness of 1·8 and 2·4 metres.

On the average this coal contains—

| | |
|---|---|
| Carbon | 62·28 per cent. |
| Gaseous compounds | 33·12 „ |
| Ashes | 3·82 „ |

It is in fair demand as gas coal, and is conveyed as such to Boston and New York in spite of an import duty of 75 cents (3s. 3d.) per metric ton. It yields on the average 280 cubic metres of gas and 0·67 metric tons of coke per metric ton. In Canada itself this coal is subject to a duty of 10 cents (5d.) per ton.

The following table gives a return of the entire yield of the Acadian coal district* :—

| | Metric Tons. | | Metric Tons. | | Metric Tons. |
|---|---|---|---|---|---|
| 1827 | 11,491 | 1855 | 216,338 | 1872 | 880,950 |
| 1830 | 25,240 | 1860 | 304,129 | 1873 | 1,051,467 |
| 1835 | 57,813 | 1865 | 635,586 | 1874 | 1,872,720 |
| 1840 | 98,267 | 1870 | 625,769 | 1875 | 781,165 |
| 1845 | 137,908 | 1871 | 673,242 | 1876 | 709,646 |
| 1850 | 163,728 | | | | |

* HÖFER, Die Kohlen- and Eisenerz-Lagerstätten Nord-Amerikas. Vienna, 1878.

In 1875 the number of mines actually working was 16, giving employment to 3,083 men.

The industries concerned in the utilisation of the native ores, chiefly of the *iron ores*, are in as backward a state as coalmining. Canada certainly appears to possess an abundance of all possible descriptions of iron ores. Magnetic and titanic ores, for instance, are found in the Beauce and Vaudreuil districts, chromic ore near Bolton. The magnetic ores average from 52·72 to 67·94 % of iron, the hematite ores from 54·36 to 68·35 %. The former are conspicuous on account of the small amount of phosphorus they contain, whereas the latter are much more impure in that respect. Apart from these there are found ilmenites, limonites, and bog ores.

The output of iron ores amounted in 1871 to 129,363 metric tons only, of which but little was worked up within Canada itself. Of manganese ores 635 metric tons were raised in the same year.

Of other materials which are used in the manufacture of iron Canadian graphite must be mentioned, as this mineral is very scarce in America, and is partly supplied from Europe and from Ceylon.

Some forge pig-iron exhibited at Philadelphia was said to be produced from Canadian magnetic ores by means of petroleum and steam, but no further information concerning it could be obtained.

If we consider that up to the year 1874 there were not more than 17 charcoal blast-furnaces in Canada, the greatest part of them being very small in size and several out of blast or tumbling to pieces, it will be apparent that the production of Canadian pig-iron cannot but be very inconsiderable, and hardly exceeding 10,000 metric tons per annum. A part of the surplus of the ores raised is sold to the United States. The most extensive concern is that of the Steel Company of Canada at Londonderry in Nova Scotia, consisting of 3 blast-furnaces, 2 foundries, a rolling-mill, and a steelworks. During 1876 this company raised 15,274 metric tons of iron ores. But even now the greatest part of the iron required is supplied from England, at the rate of 153,575 metric tons in 1870, and of 163,576 metric tons in 1874.

The principal conditions of a considerable iron industry—good ores, large forests, and coal deposits—are no doubt existing; what is wanting is most likely the requisite capital, a protective tariff, and the necessary means of communication. As much as 7,985 kilometres of railway existed however in Canada at the end of 1877.

*Newfoundland.*—Considerable coal deposits have lately been discovered on this British island.

*Manitoba.*—In this territory, which has only been colonised in the course of the last few years, lignite deposits exist on the Saskatchewan river. The regions bordering the north-western parts of it are also said to exhibit seams of coal in different localities.

*British Columbia.*—This colony is abundantly provided with gold, copper, iron, and coal. Considerable deposits of coal exist on *Vancouver Island*, on the eastern coast of which there is a basin 210 kilometres long and 21 kilometres broad, where seams of lignite have been discovered in many places. It is worked from two pits in the vicinity of Nanaimo, in the southern part of the basin. A seam of nearly three metres thickness is being worked in the northern part, near Comox, but no reports concerning the output are at hand. The coal of Vancouver Island, a great part of which is also suitable for coking, contains from 51·45 to 68·27 per cent of carbon, and from 2·86 to 10·10 per cent of ashes.

The output amounted—

| | | | | |
|---|---|---|---|---|
| in the year | 1870 | to | 29,863 | metric tons. |
| „ | 1874 | „ | 81,546 | „ |
| „ | 1875 | „ | 110,145 | „ |
| „ | 1876 | „ | 140,185 | „ |

A native industry of any importance has had no more chance of growing up here than in Canada. Here, as there, the coal is principally used by the steamers arriving in the British ports. A considerable portion of the output is shipped to San Francisco, the chief market for coal on the shore of the Pacific, where, at the end of June 1876, it was sold at $8 to $9 (£1 14s. 2d. to £1 18s. 5d.) per metric ton.

On the neighbouring *Queen Charlotte Islands* iron pyrites are found everywhere in the largest quantities. Near Harriet Harbour, on Moresby Island, westward of Burnaby, hills are found consisting entirely of a single mass of pure magnetic ore, containing 82½ per cent of pro-oxide, and 4·60 per cent of protoxide.

Coal has also been discovered southward of Trapp Straits. Mr. POOLE saw samples of anthracite, equalling, in his opinion, the well-known Pennsylvanian for the use of blast-furnaces.

From England there were exported to British North America in 1875, 140,789 metric tons of coal, of a value of £791,866; and 1,327 metric tons of coke, of a value of £1,299.

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# MEXICO.

## 1,921,240 SQUARE KILOMETRES. 9,276,079 INHABITANTS.

COAL deposits of any considerable extent have as yet not been discovered in Mexico; iron ores are, however, found in most of the provinces. A hill, more than 180 metres high, consisting of first-rate iron ores containing more than 60 per cent of iron, is situated in the Durango Valley. When the Spaniards first heard of it, Don GINEZ VASQUEZ DEL MERCADO was despatched to take possession of it, as they believed it to contain gold. He found only iron, of which he took no further notice, as being of no use to his countrymen. Only of late some workings have been commenced there with a view to turn this immense treasure to some use.

Other iron beds are found in the provinces of Mexico Proper, Guerrero, Jalisco, Mechoacan, Oaxaca, Puebla, and in the Tlascala district. ALEXANDER VON HUMBOLDT wrote 70 years ago: "If we consider the enormous area covered by the Cordillera ranges, and the immense number of ore seams known, but not examined, we must admit at once that £6,000,000 worth of gold and silver—the whole output of precious metals of entire America—could be supplied by Mexico alone if under a better administration and with a more industrious race of inhabitants."

There are seven ironworks in the country, the Comanjo works being the most important of them. Here, as well as at the Tula works, the excellent ores of the province of Jalisco are worked, and the quality of the iron produced is very good. In the province of Hidalgo two ironworks are at work. The Zacualtipan works, where hematite ore is used, and the Ferreria de la Encarnacion, where pig-iron, made from magnetic ores by two charcoal blast-furnaces, is converted into wrought-iron in open fires and tilted or rolled into merchant bars. The other three Mexican ironworks are Terro Mercado, in the province of Durango; Ferreria de la Trinidad, in Puebla; and Temascaltepec, in Mexico proper.

Of the annual production of iron in Mexico no reliable returns are at hand. It is estimated at 7,500 metric tons.

The entire yield of mining operations, exclusive of that of the gold and silver mines, is valued at £80,000 per annum.

The value of the import of English iron and hardware in 1875 was £45,405; from the United States, however, more than double that quantity is imported.

The mileage of the Mexican railways at the end of 1877 was only 623 kilometres.

# CENTRAL AMERICA.

## 569,633 SQUARE MILES. 2,828,164 INHABITANTS.

*Guatemala.*—This state does not seem to possess much mineral wealth. Only on the Honduras frontier (in the Chiquimula district) gold, silver, copper, and lead have been found. Coal and iron ore mines do not exist any more than a manufacturing industry of some extent, which might be productive of a demand for coal. Steam navigation is supplied with North American coal, and the first railway is at present in course of construction. All hardware, as well as bar, hoop, &c., iron, is brought from England and the United States.

*Honduras.*—This country is rich in precious metals, and in *coal* and *iron* besides. Mining, however, is in a very backward state. In 1877 railway lines of 90 kilometres extent had been opened.

*San Salvador.*—A very good description of *coal* and large quantities of *iron ores* are found in the Rio Lampo valley of the Metopam district. The production, however, is insignificant and confined to the home demand, the transport to the sea-coast being, in consequence of the remote situation of the mines, very difficult and too expensive.

*Nicaragua.*—*Coal* was discovered about the year 1860, near the Lake of Nicaragua, in the Chantales district. Iron ores are also existing in this state, but the mining industry is hardly worth mentioning.

*Costa Rica.*—The mountains of this country contain coal seams, and iron, copper, and lead ores, but nothing is actually being mined. The railway lines opened at the end of 1877 were of 59 kilometres length.

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# THE WEST INDIES.

## 245,509 SQUARE KILOMETRES. 4,316,178 INHABITANTS.

On the island of *Cuba* only lignite is mined; the coal deposits existing there are not worked at all. Iron ores are very scarce there.

In the northern mountain ranges of *San Domingo* coal seams have been frequently observed, but in consequence of the unsettled state of the country they have never been thoroughly investigated.

On the French island of *Guadeloupe* magnetic ores, containing 74·8 % of iron, are known to exist.

The total import of English coal into the West India Islands in 1875 consisted of 475,099 metric tons, of a value of £327,016. The mileage of railways at the same time was :—

| | | |
|---|---|---|
| On Cuba | 640 | kilometres. |
| „ Jamaica | 43 | „ |
| „ Porto Rico | 34 | „ |
| „ Barbadoes | 10 | „ |

# BRAZIL.

## 8,337,218 SQUARE KILOMETRES. 11,108,291 INHABITANTS.

THE continent of South America was until recently considered nearly devoid of mineral fuel, and the indispensable supply of coal had to be imported either from the United States or from England, and to be retailed in the seaport towns at enormous prices (£1 8s. 7d. per ton for English coal, which was sold in England at 4s. 10d). This fact sufficiently explains the consideration bestowed of late upon the provinces of Santa Catarina and Rio Grande do Sul of southern Brazil, where several *coal deposits* have been discovered during the last ten years.

The first of these deposits is situated on the right bank of the Tubarao river, in the province of *Santa Catarina*, at a little more than 50 kilometres distance from the outlet of that river into the South Atlantic Ocean. It has been investigated to a somewhat large extent by several openings.

The whole number of openings made was six, the greatest depth being 3·5 metres. The number of coal seams varied from two to twelve. They are separated from each other by thin bands of clay-slate. The quality of the coal is much deteriorated by pyrites. It is a dark glance coal, and very liable to crumble into large and small cubical pieces when exposed to the atmosphere for some time. Like every description of coal of more recent geological age it is highly bituminous, and returns but a small percentage of coke. In heating power it is inferior to English coal.

The second coalfield is situated in a more western portion of the province of Santa Catarina, on the slopes of the Serra Geral, and near the sources of the Jaguarao river. It is stated to be of 170 square kilometres extent, and very similar to the previous one as regards the geological structure and quality of the seams and of the under and over lying strata. The number and thickness of the coal seams have not been reported.

The third coalfield of southern Brazil is situated about 300 kilometres further to the south than the last one, in the province of *Rio Grande do Sul*, between the northern slope of the Serra Erval and the navigable Jacuhy river.

One seam of more than two metres thickness, as well as some lesser ones, all divided by bands of clay-slate, may be traced for a considerable distance, alternating with sandstone and clay-slate strata. This coal is likewise similar to that of the Tubarao seams. It is deteriorated by pyrites, sandstone, clay-slate, and clay to such an extent that the better seams have to be worked separately. The two metres seam above mentioned is comparatively regular, and contains coal of a fairly good quality—the only description tried by the Brazilian Government on board their steamers.

As a depth worth mentioning has nowhere been reached, it is at present impossible to obtain a correct notion of the importance of this coalfield any more than of the two previously mentioned. It is, however, not unlikely that at a greater depth the quality of the coal may turn out better and that the thickness of the seams may increase. Under such circumstances it is not out of place to raise the question as to whether coalmining may be made to pay in this case, *i.e.*, how far the output may successfully compete with the better North American and English coal in the markets of South Brazil.

As the seams are cropping out at the surface in a very hilly and even mountainous region, there is ample opportunity afforded to work them by drifts, and to dispense thus with the erection of expensive pumping machinery for a long time to come—a very important advantage for those districts. The local circumstances accordingly are on the whole favourable for mining operations, and the coalfields are connected with the markets on the South Atlantic Ocean

by the navigable Jacuhy and Tubarao rivers. Equally good means of inland transport, chiefly to the German colonies of San Leopoldo, Santa Maria, and Boa Bista, &c., are afforded by the navigable watercourses of the Taquary, Cahi, and Sino, which are in connection with the Curral Alto river.

Endeavours to utilise this mineral wealth have not been wanting, as a few mines have actually been opened. In the province of Rio Grande do Sul two mines are being worked—the Candiosa colliery, owned by an English company, which is about to construct a railway for the transport of its coal, and the Arroio dos Patos colliery, owned by another English company, which is already connected by rail to the Lagôa-dos-Patos river. The output is in fair demand for steamers. A concession for working the Santa Catarina coalfield has likewise been conferred.

The quantity of English coal imported into Brazil was:—

| | | | | |
|---|---|---|---|---|
| In the year 1875 ..... | 369,882 | metric | tons, of a value of | £293,517 |
| „ „ 1876 ..... | 331,777 | „ | „ | 217,347 |
| „ „ 1877 ..... | 345,524 | „ | „ | 206,025 |

*Iron ores* are found in Brazil under equally favourable conditions as coal. Along the whole extent of the Itabira range, in the proximity of the town of Uro-Preto, in the Espinhaso mountains and the Piedade hills, and at many other places of the province of Minas-Geras, enormous quantities of ores are found. In the northern provinces, as well as in San Pedro, Rio Grande do Sul, and Parana, an abundance of iron ores is likewise known to exist, a part of them being of first-class quality. Magnetic ores containing 72·5 per cent of metallic iron are most common. Notwithstanding these favourable conditions the Brazilian iron industry is still in its infancy. An iron-making company has been constituted in the province of Minas-Geras, but nothing has transpired so far as to the results. The most important mine in South America is in the province of San Paulo, on the right bank of the Ipanema river, at a distance of 191 kilometres from the port of Santos, of 425 kilometres from the capital of the province, and of about two kilometres from the foot of the Arassoiava mountain. It is owned by the State, and gives employment to 100 hands. At a distance of 33 kilometres from it a coal deposit has been discovered, which is expected to prove beneficial to this mining concern.

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# CHILE.*

## 328,175 SQUARE KILOMETRES. 2,138,800 INHABITANTS.

THE existence of *lignite* in Chile has been known since the year 1825. The most important deposits are found in the tertiary formations of the province of Concepcion, southwards of the Biobio river, extending nearly to the 37th degree of southern latitude. The Lota, Coronel, Lebié, and Colchura mines are worked in a very extensive way.

The only coal deposits besides these, which are actually being worked, are

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* LITERATURE: Estadistica comercial de la Republica de Chile, Valparaiso, 1877. Memoria del Ministro de Hacienda, Santiago, 1877. B. FLEMMING: Die Kohlen-und Kupferminen Chile's. Globus, Vol. XXXII.

those in the territory of the Magellan Straits, of a geological age dating from the interval between the cretaceous and the melassic period; they have only lately been opened.

The coal is of a rather inferior and variable description, being partly fibrous or soot-coal, partly pitch-coal or lignite. It differs from English coal by the disagreeable resinous smell and the great volume of smoke it produces when burning.

The deposit of the Magellan Straits is on the Rio de las Minas river, at about 9·7 kilometres distance from the shore and the colony of Punta Arenas. One seam of fairly good lignite, varying in thickness from 2·5 to 3 metres, is actually being worked. The aggregate production of the workings there exceeds 10,000 tons per annum. One pound of this coal is stated to raise 5lb. of steam, the performance of English coal being 7lb. to 8lb. Of late, some Chilean capitalists have combined for the purpose of working these mines on a large scale. The steamers of the Pacific Steam Navigation Company, and those of the Hamburg line, are now putting regularly into Punta Arenas for coaling.

The greatest portion of Chilean coal is, however, raised in the province of Concepcion, as has already been stated. The Lota mines were started in 1841 by the Liverpool Steam Navigation Company, and some extensive copper smelting works were erected in the neighbourhood. The town of Coronel is four miles to the north of the mines, to which tile, glass, and engine works of considerable extent have been added.

Another place where coal has been discovered is Lebió, which is situated about 350 kilometres southward from Lota, but which has only been known since 1860.

The total production of all coal mines of the Republic of Chile (those of Punta Arenas excepted) was 300,000 tons in 1872, and had increased to 360,000 tons in 1875.

The Chilean coal deposits and the copper works of the country, which already supply more than one-half of the entire demand of copper all over the world, are of great mutual importance to each other. Although the coal and copper districts of Chile are entirely separated from each other, yet the intercommunication between them is facilitated by the circumstance that all the coalmines, as well as copper mines, are either close to or at no great distance from the sea coast.

The present yield of Chilean coal is, however, insufficient to supply the large quantities consumed by the copper works, and the remainder of the home demand; accordingly, considerable quantities have to be imported, chiefly from England, only a small portion coming from the United States.

The extent of the Chilean coal traffic is illustrated by the following figures :—

| Year. | Import. | | | | Export. | | Native Coal carried by Coasting Traffic. |
|---|---|---|---|---|---|---|---|
| | Total. | | From England. | | | | |
| | Metric Tons. | Value in £. | Metric Tons. | Value in £. | Metric T. | Value in £. | Metric T. |
| 1872..... | 60,737 | 89,555 | 60,600 | 89,355 | 64,582 | 112,911 | 181,469 |
| 1873..... | 125,324 | 215,396 | 125,020 | 214,950 | 28,138 | 59,158 | 205,212 |
| 1874..... | 115,662 | 170,305 | 114,517 | 168,616 | 43,147 | 87,999 | 339,704 |
| 1875..... | 127,226 | 187,583 | 120,794 | 178,100 | 38,436 | 52,369 | 261,640 |
| 1876..... | 116,759 | 174,162 | 115,243 | 171,922 | 47,020 | 67,949 | 303,716 |

It will be seen from this table that the import of foreign coal, in 1873, represented an increase of 58 per cent on that of the previous year, the export of native coal declining at the same time to less than one-half. This singular fact is, however, explained by the abolition of the import duty on coal in 1873, which caused a rapid increase of the import of English coal.

The coal exported from Chile is mostly carried to Peru, Bolivia, and the Argentine Republic. The export from the above-mentioned colony in the Magellan Straits is, however, not comprised in the above returns.

Chile has already been very busy in railway construction, with a view of connecting the mining districts in the interior of the country, and on the western slope of the Cordilleras with the numerous seaports of the country. The mileage of the lines opened to traffic at the end of 1877 was 1,689 kilometres.

*Iron* is only produced in small quantities, although it is found near Atacama in an almost metallic state. The entire demand of iron will still have to be supplied from abroad for some time to come. The import was—

| | 1875. | | 1876. | |
|---|---|---|---|---|
| | Metric Tons. | Value in £ | Metric Tons. | Value in £ |
| Pig-iron ..... | 4,586 | 44,376 | 4,388 | 44,649 |
| Plates and Sheets ..... | 420 | 6,620 | 621 | 9,356 |
| Galvanised Iron ..... | 1,006 | 27,886 | 2,013 | 50,505 |
| Hoop-iron..... | 1,043 | 13,860 | 602 | 8,372 |

Of these quantities 98 per cent comes from England, and the remainder from the United States and Germany.

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# REMAINING COUNTRIES OF SOUTH AMERICA.

## 8,988,307 SQUARE KILOMETRES. 13,062,600 INHABITANTS.

*Columbia* (New Granada).—Large quantities of coal exist in this country, but no steps have hitherto been taken to raise these treasures. Recently some workings have been started in the Rio Hacha coalfield. Other coal seams have been found in the provinces of Cartagena, Bogota, Chiriqui, Soata, and Panama.

A quantity of 4,993 metric tons of coal, of the value of £2,933, was imported from England in 1875.

The iron ore beds near Pacho and Panama also deserve notice.

Extent of railways at the end of 1877, 106 kilometres.

*Venezuela.*—A real mining industry cannot be said to exist in Venezuela at present. Even precious metals do not attract much attention. Only a little gold is got from alluvial sand by washing operations of a most superficial description. Rich *coal* and *iron ore* deposits exist, but are not being worked. Manufacturing industry of any description in Venezuela is still out of question. Owing to the abundance of timber and firewood, the few distilleries and sugar manufactories are able to dispense with coal. Comparatively insignificant quantities of it are imported; the English import, for instance, in 1875 being 426 metric tons, of the value of £301; but the import of *hardware* is considerable.

The length of the railways opened at the end of 1877 was 126 kilometres.

*Guiana.*—In Dutch Guiana rich deposits of iron ore are known to exist. Length of railways in 1877, 96 kilometres.

*Ecuador.*—Numerous bands of *iron ores* are found in the mountain ranges of this country, without being, however, worked with anything like activity. The manufacture of iron castings is fairly advanced.

The length of railways in Ecuador was 41 kilometres at the end of 1877.

*Peru.*—This country has an ancient fame for its mineral wealth in general, and especially for its abundance of precious metals. The high costs of transport have proved obstructive to the working of the numerous coal seams of Peru, which are found in the interior of the country, some of them being up to 5·6 metres thick. The coal of the Huaylas district is of a much superior quality. It commenced to be worked when the Chambote and Huaraz railway had been opened for traffic. When this line was in course of construction some other important coal seams were discovered, the contents of which are said to be equal in quality to good English coal. The Huallanca and Cerro de Pasco deposits also deserve notice. Apart from the coal mined within the country, imported Chilean and English coal is being used—the latter in 1875 at the rate of 115,854 metric tons, of the value of £89,767, and of 1,756 metric tons of coke, of the value of £1,773.

Enormous quantities of *iron ores* are found in the range of the Cordilleras nearest the sea, but they are not worked, as precious metals and copper ores are mined with greater profit. The import of English pig-iron and hardware in 1874 was of the value of £320,639, and declined in the following year to £210,961.

During the last years, a railway system of considerable length has grown up in Peru, the extent amounting at the end of 1877 to 1,582 kilometres, and promising to be considerably increased in the immediate future.

*Bolivia.*—Gold and silver mining, which, for want of capital and machinery, is carried on in a most primitive manner, is the chief pursuit of the inhabitants.

On the Queboya Islands, in Lake Titicaca, some strata belonging to the carboniferous system and resembling the mountain limestone of England, have been discovered by D'ORBIGNY.

Coal has actually been discovered in the proximity of this lake, in 1864, and good lignite in the province of Tarija, where abundant quantities of petroleum exist also. The import of English coal amounted in 1875 to 4,133 metric tons, of the value of £2,394. Iron ores are not wanting either.

Length of railways at the end of 1877, 130 kilometres.

*The Argentine Republic.*—Extensive deposits of bituminous coal and of iron ores have recently (1872) been discovered in the province of San Juan. Up to the present, the demand for coal has been satisfied from England, the import amounting in 1875 to 50,725 metric tons, of the value of £40,402.

Apart from cotton and woollen goods, the import of this country mainly consists of iron. The import of English pig-iron and hardware, in 1875, was of the value of £579,915.

Length of railways at the end of 1877 : 2,240 kilometres.

*Paraguay.*—This country is abundantly supplied with natural products of every description. But the metal industry is altogether insignificant, agriculture being the principal pursuit of the inhabitants. Coal has not been discovered in this country up to the present.

Length of railways in 1877, 72 kilometres.

*Uruguay.*—Stock breeding is the principal pursuit of the inhabitants, agriculture and manufacturing industries being still in their infancy.

Coal and iron are entirely wanting here. English coal was imported in 1875 at the rate of 118,720 metric tons, of the value of £93,427 ; and English hardware of the value of £116,749.

The milage of the railways of this country is 376 kilometres.

*Patagonia.*—M. MUSTERS reports to have found iron ores at different places

in this country, in contradiction of the opinion hitherto prevailing, that useful minerals were not to be expected eastward of the Andes.

*General Remarks.*—The tertiary formations of South America are of an enormous superficial area. The tertiary basin of the Pampas extends from the River Plate to the Straits of Magallan, and a portion of it is covered by the Atlantic Ocean. The lower portion of these tertiary formations generally consist of three strata, the lowest being a ferrugineous sandstone containing globules either of red oxide or hydro-oxide of iron, and attaining a maximum thickness of 90 metres. The following stratum is an argillaceous limestone of almost white colour, full of round grains of hydro-oxide of iron, and of 3·9 metres maximum thickness. The third stratum is the uppermost one, and, like the preceding, 3·9 metres thick. It consists of gypsiferous clay, without oxide of iron. This tertiary basin of the Pampas extends between 19° and 52° of southern latitude, at a length of more than 3,864 kilometres.

The climate of the most southern portion of America seems to be eminently suitable for the formation of *peat*. On the Falkland Island nearly all descriptions of plants are converted into this substance. Some of the peat deposits are of considerable thickness, coming up in some cases to 3·7 metres. The undermost portion of the peat is earthy. If dried it hardens considerably and burns freely. The Chinas Islands, under 38° of southern latitude, may be considered as the most northern part of the district where this conversion is effected by the climate.*

* DARWIN, Travels, &c. Vol. i., p. 307, and Vol. ii., p. 42.

# ASIA.

## ASIATIC RUSSIA.*

### 15,809,280 SQUARE KILOMETRES. 8,079,213 INHABITANTS.

THE returns of production have already been given in our article on European Russia.

Up to the present time seventeen different coal deposits have been discovered in Asiatic Russia, partly belonging to the coal measures proper, partly to the jurassic formation.

*The coal deposits on the eastern slope of the Ural.* — The discovery of well-promising coal seams which have recently been found not only on the western but also on the eastern slope of the Ural, is of the greatest importance for the railways projected in Siberia. Herr G. VON HELMERSEN reports that four anthracite seams have been found near the Reshewskoi works, north-eastward from Jekaterinburg, and several coal seams near the Kamenskoi works, to the east of Jekaterinburg; that several workable seams have been opened near Suchoi-Log, and that there is every prospect of finding many more. The mining officials have ordered the necessary investigations to be made.

*The Kusnetsk district on the Altai, in the Department of Tomsk (Siberia).*— Coal has been mined on the northern slope of the Altai mountains in the vicinity of Kusnetsk since 1850; and, according to impressions of plants, which have been found in the adjacent layers of sandstone and shale and which have been investigated by Professor Dr. GEINITZ, of Dresden, it belongs to the coal measures of western Europe. According to Mr. COTTA these measures are occupying a vast superficial area, but they are covered for the greatest part by diluvial and recent deposits, below which they are supposed to extend into the country near Tomsk. The best evidence is obtained from the mines and open workings in the neighbourhood of Batshask, to the north-east of Salair. The output however was, up to the present, very small (according to Von BOCK, 5,730 metric tons in the year 1870, and 3,735 metric tons in 1871). The Kusnetsk district is owned by the Crown, and the coal, which is very suitable for coking, has so far only been used at some of the Imperial works, the Gawrilowsky silver, and the Gurzewsky ironworks. The annual production of iron averages 2,460 metric tons. The Kolywan coal-seams have only lately been opened, and are of such an extraordinary thickness that their coal will soon supplant the charcoal hitherto used.

The same coal measures are also appearing in the neighbourhood of Kuria, on the northern slope of the Altai.

Concerning the coal district on the *Nishne-Tugunska* (in the Jenissei district),

* According to HOCHSTETTER'S "Asien und seine Kohlenschätze."

where, according to LOPATIN, the silurian formation is overlying the coal measures. More detailed reports are wanting.

*The basin of the Kirghise Desert.*—The country around Semipalatinsk has lately become more important owing to the discovery of extensive coal deposits. Coal is chiefly found in the Permykinsk basin, in a pit about 100 kilometres distant from Semipalatinsk, and in the pits Talldykulsk, Maukobensk, Kysyltawsk, and Dshemantysk, all of which are situated in the basin of the Pawlodar district—lastly, in two pits in the Karkalinsk district. Besides, there has been a pit opened near Ermensk, at a distance of about 141 kilometres westward from the Alexandrowski works. All pits are in the possession of the Popow family, and more than 49,140 metric tons of coal have been raised from them since 1840.

The *Russian Review* gives the following particulars respecting the Semipalatinsk deposits: "The coal deposits of the Akmolinsk, Bajan-Aulsh, Karkalinsk, and Pawlodar districts of the Akmolinsk Department, and the Semipalatinsk district of the Semipalatinsk Department, belong to the district of the Kirghise desert. In the Akmolinsk district coal is only mined in the Karagantin pits belonging to the Spasski metal works of Messrs. Risanow and Ushakow. In the year 1870 the output was 6,721 metric tons, and in 1871 it was 6,626 metric tons. In the Semipalatinsk Department, coal is raised from four pits: from the Maukobensk and the Kysyltawsk pits of Messrs. Popow; from the Spasski (Permykinsk) and the Dungulek-Sor pits of the Irtysh-Daghestan Company. Messrs. Popow have erected copper and silver smelting works near the Kysyltawsk pits. The output of coal in the year 1864 was 875 metric tons, in 1869 2,922 metric tons, and in 1871 12,480 metric tons. Coal mining will increase still more if the project of a railway across the northern portion of the desert from Orenburg to the Sea of Aral should prove feasible by Major-General BESWASSIKOF'S investigations, in which this gentleman has been engaged during the last years."

*The coal deposits in the Caucasus and in Transcaucasia* have scarcely been investigated, and have as yet no influence upon industry. The following deposits are known: (1) That of Tquirbul, near Kutais; (2) the Humarin deposits on the river Kuban; (3) that near the fortress of Grosnaja, behind the Terek; (4) a deposit not far from Bambar; (5) a seam in the pass of Kana-Syrga, in the Derbend Department; (6) one near to Achalzich; (7) one on the Tekie promontory.

The Tquirbul (Tquibuli) basin, on the southern slope of the mountain, 40 miles from Kutais on the Rion, is of some importance, on account of the good iron ores found in the same locality, and of the railway line from Poti to Tiflis, by which it is intersected and which has been open for traffic since 1872. The seams of this deposit, which has been proved to extend over a length of 15 kilometres, are up to 14 metres thick, and their contents have been calculated to be 1¼ million metric tons; but even the railway mentioned before is still using wood as engine-fuel, as regular workings have not yet been taken in hand.

The coal from the sources of the Kuban, near Ghumara, on the northern side of the mountain, is most likely of the same geological age. The mine is worked by the Crown, and the annual output in the last years averaged about 2,450 metric tons. The coal is conveyed to Pjatigorsk and Stawropol for domestic use.

Besides these, some lignite mines are actively at work in the neighbourhood of Tiflis.

An account of the coal on the peninsula of Mangyshlak, on the eastern shore of the Caspian Sea, has been given by Herr G. VON HELMERSEN, according to whom it belongs to the Lias formation. But it is said to be of very inferior quality, and liable to spontaneous combustion, on account of a considerable admixture of pyrites. Owing to this it has not yet been worked.

Apart from this it is in the interest of parties concerned in the Baku naphtha works, who want to dispose of their naphtha residues, not to allow any competition by means of cheap coal. According to Dr. TIETZE'S report, nearly all steamers on the Caspian Sea are now fired by naphtha residues, their boilers having been especially adapted for this fuel, which is sold at 5½ kopeks per pud (1s. per metric cwt.), the price of Donetz coal in Baku being 55 to 60 kopeks per pud (10s. 7d. to 11s. 7d. per metric cwt.)

The coal, which is found in the country of the *Orenburg Kirghises, near Uralsk*, and in the recently constituted Turgai district of the Kirghise Desert, principally on the sources of the Dshilantshik, is described as lignite. It appears however to have only been worked to a very slight extent, if at all.

*The Turkestan coal district on the Karatau in the Sir-Darja territory.*—M. A. S. TATARINOW, who has been for several years engaged in geological researches in the Sir-Darja territory, reports that the coal deposits opened in 1867 in the Ala and Karatau mountains, between Aulie-ata and Tshemkend (north-east of Tashkend), have been proved to allow of a very considerable output. At present they only serve to supply the steamers plying on the Sea of Aral with fuel. The output of coal in the Ak-tasty-bnlak will keep pace with the activity in iron and copper smelting, which industries are only wanting the necessary capital and enterprise. Here nature has provided everything necessary for a great industry—coal, iron, copper, and lead ores being found together. But the inhabitants have not yet understood how to utilise these treasures. In Southern Asia the use of iron for agricultural implements is very scarce, and parts made of iron are treated with a care that is sufficiently indicative of the high price of this metal so common with us. The ploughs are generally fitted with *cast-iron* coulters. The inhabitants of Turkestan are exceedingly awkward in making the most common iron tools. They were taught the art of iron-melting by the Chinese as early as in the first century before Christ. Their wrought-iron is brittle, and the objects made from it are only fit for a people on an exceedingly low scale of civilisation.

Von BOCK makes the following remarks respecting this coal district: "The coal-seams existing there are partly owned by the Crown, partly by private persons. The output of the Tatarinowsk coalmines was, during the last years, from 1,150 to 1,300 metric tons per year; and in two mines, owned by private individuals, the Babatin and the Hodshensh (Fawitzki) mines, 850 metric tons of coal were raised in 1869."

Other coal-seams, which were discovered in Russian Turkestan by Russian mining engineers several years ago, are in such an unfavourable situation as regards means of communication—the only available ones being the backs of camels and horses, as practicable roads are entirely wanting—that up to the present they have not been worked at all.

In the district of Ton-Tau, eastward from Samarcand, the traveller ALEXANDER LEHMANN, from Dorpat, discovered good coal as early as the year 1841. The same traveller has found burning coal-seams in the upper valley of the Sarafshan (in the southern frontier range of Chokand). FEDSHENKO refers to this locality under the name of Kan-Tag, a mountain, where sulphur is got (burning coal-seams).

Accordingly there can be no doubt of rich coal deposits existing in the vast districts of Central Asia, of which very little is known at present.

Respecting the coal deposits near *Sergiopol*, in the Semirjetshinsk district, and those near *Kuldsha*, on the Ili, which have already been worked by the Chinese, more detailed accounts are wanting.

Besides the localities mentioned, other coal deposits are known in Asiatic Russia, as, for instance, at different places in the Department of Irkutsk, in the Nertshinsk district of the Transbaikalian territory on the Argun, and not far from the mouth of the river Amoor. From one of the ranges of the Zagajan

mountains, by which the Amoor Valley is bordered, black smoke has been observed to ascend at several places, and has been ascribed to spontaneous ignition of some coal seams. According to the reports or Count MOURAVIEFF, the late governor, the whole Amoor district is full of enormous coal and iron ore deposits. Mining and smelting operations, however, have not been commenced up to the present.

*The Island of Saghalien.*—On this island, formerly belonging to Japan, but now to Russia, some coal seams near the factory of Dui, on the south-western coast, have been worked by the Russians as far back as 1853. Up to the present coal seams have been discovered in 12 localities of this coast district, but workings have only been opened at the place before-mentioned and at Sertunai. The seams contain only lignite, which, however, is of excellent quality, the average percentage of carbon being 70. It is sold at £1 8s. 4d. per metric ton, and is preferred to the Japanese coal. The production has considerably increased during the last few years. Some Petersburg capitalists and leading tradesmen have constituted a joint-stock company for the purpose of working the Saghalien deposits. A portion of the output is exported to China.

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# ASIATIC TURKEY.*

## 1,925,550 SQUARE KILOMETRES. 13,141,641 INHABITANTS.

THE only *coalmine* in the Turkish Empire has already been mentioned in our article on European Turkey. It is situated near *Eregli* or Bender-Eregli (Heraclea pontica of the ancients, Penderachia of the middle age), in *Asia Minor*, on the southern coast of the Euxine. Coal was discovered there in 1834, but only as late as 1841 workings were commenced by some Austrian Croats and Montenegrins. According to different investigations made since that time this coalfield has been proved to reach as far as Amassra (Amastris of the ancients), at a distance of 105 kilometres, while in the landward direction it may be assumed to extend from 8 to 11 kilometres, the seams going down as far as 300 metres. The most productive workings are those opened near Armudshik and Kozlu, where one seam of 4 metres thickness and five or six others of 1·5 to 2·0 metres thickness each are being worked. The mines are at present owned by the Crown. The production of this coalfield, which is one of the richest existing, is very inconsiderable, and the mines are worked in the most careless and wasteful manner. Anyone being in possession of a "teskere," which may easily be procured from the Admiralty, is entitled to search for coal, and, if successful, to work it on account of the Government. The latter has a right of forestalment on the coal, for which it pays from 3½d. to 5d. per metric cwt., no coal being allowed to be sold to other parties.

In consequence of this manner of working, the value of these mines declines from day to day. The miners never go down to a depth exceeding 80 to 100 metres, and abandon their workings for new ones as soon as they are troubled by water or firedamp, and in this unsystematic manner the entire district is

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* LITERATURE: SCHWEGEL, Volkswirthschaftliche Studien über Constantinopel und das umliegende Gebiet.

honeycombed by innumerable workings. Even means of communication have not been provided for. The coal is transported in the most primitive manner in baskets carried on the back, notwithstanding the proximity of Heraclea, a town in a situation equal to that of Cardiff and Newcastle, and possessing facilities for establishing communications with some other points of the non-distant sea-coast.

The Eregli coal is of a laminated texture, and equal in quality to good English coal; the best descriptions of it are got at Sanguldagh.

The annual production is from 100,000 to 125,000 metric tons. In consequence of the frequent reloading it arrives at Constantinople in the shape of slack, and is sold there at eight piastres per cwt. As 18 Turkish cwts. are equal to one English ton, the price per metric ton would be 144 piastres or £1 7s. 5d., or almost equal to the price of best Cardiff or Newcastle coal delivered at Constantinople, which is from £1 7s. 5d. to £1 11s. 2d. per metric ton. It is however to be noticed here that the Eregli coal is not offered for sale at present, the entire output being consumed by the Imperial arsenal.

As no second deposit of equal excellence and as near to the sea is found in the whole Turkish Empire, the conditions under which a foreign company would obtain a concession there from the Government are quite exorbitant. It is, however, beyond doubt that not only Constantinople, but also the whole cost of the Euxine could be entirely supplied with coal from this deposit if a rational method of working could be introduced there.

The further extent of these coal measures has been proved near Sinope, Kerasund, Bujuk-Liman, and as far as Kowata to the east of Trebizond, but no quantity of coal worth mentioning is raised at any of these places.

When M. CERNIK conducted his surveying expedition from Bagdad upwards in 1873, he discovered a coal deposit in central *Kurdistan*, at some distance out of the caravan tracks usually followed in the Chabur valley. This valley is 22 kilometres long, and at its extremity divided into two valleys followed by the two springs of the Chabur river, an eastern tributary of the Tigris.

The principal village of the valley, Zacho, has 2,000 inhabitants. The seams, which are cropping out at the surface, are 3 metres thick. The hills consist of sandstone strata of 2 decimetres thickness. Coal is only found in the little Sheramish valley, but in the Djebel Herbol asphalte is mined, which is carried down the Tigris on air-bag rafts, called "Kellek," of 6,000 Okken (=6·75 metric tons) capacity, and delivered in Bagdad.. The Sheramish coal seams are not being worked.

A mineral railway line of 4ft. 8½in. gauge has been projected by M. Cernik to branch off from Feysh-Chabur, a little Nestorian town of 2,000 inhabitants. At this place the main line is crossing the Tigris, and is projected to Bagdad *vid* Mosul. The inhabitants of the Chabur valley are Kurds.

The contents of this Zacho coalfield are as yet entirely intact, and might be of great benefit to the copper trade of Erzeroum and Diarbekir. But reflections like these do not enter the mind of the inhabitants at present. The important coal basin just before mentioned is only 33 kilometres distant from the left bank of the navigable Tigris, and 80 kilometres from Mosul; yet the coal for the steamers plying on the Tigris between Bagdad and Bassora comes from England *vid* Suez. Some coal seams, which could be very easily worked, are also said to exist on the Lebanon.

In *iron ores* Asiatic Turkey is equally rich. "The Chalybians, a people of ironworkers," were already well-known in the countries of the Euxine at the time of Herodot. They lived in the valleys near Trebizond and Kerasus, where a plentiful supply of ores was to be had, and where they are said to have invented the art of converting iron into steel.

Another Eldorado of iron is to be found in the district of Sivan Maaden, on the Murad river in the Euphrates valley, "where hills and valleys near and far are covered by large black stones containing 75 per cent of iron." They were

worked by the tribes of Mesopotamia in the most remote ages, yet they are even now plentiful, and certainly the richest iron mines of Asiatic Turkey.*

Iron deposits of enormous extent, which, however, have remained entirely intact, are found in the country beyond Broussa, to the east and south-east from Bythine Olympus.

In the Lebanon mountains iron ores of high percentage are smelted in charcoal blast furnaces of primitive construction. The iron produced is worked up into horse nails and other objects.

The mileage of the railways opened for traffic in Asia Minor up to the end of 1877 was 395 kilometres.

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# ARABIA.

## 2,507,410 SQUARE KILOMETRES. 3,720,000 INHABITANTS.

ACCORDING to MALTZAN the Aden market is supplied with coal from South Arabia.

AD. V. WREDE found a ferruginous sandstone, impregnated by ochre and hydro-oxide of iron, containing agglomerations of clay-ironstone, likewise ochre and oxide of iron in innumerable fissures, in the district between Wadi Hadjar and the plateau of Hadramaut. This sandstone is spread over the entire area of the valley between Djebel Mulk and Djebel Noman, amounting to about 30 square kilometres. In the Wadi Mayfaah, on the eastern slope, a seam of quartzeous and very rich ironstone 1·5 metre thick appears dipping, like the greywacke strata, towards west at 47°. Lower down, the Wadi el Hadenah intersects a promontory, consisting of a conglomerate of rocks, amongst which a very hard clay-ironstone is most conspicuous.

Generally speaking, the production of iron is still very insignificant in Arabia.

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# PERSIA.

## 1,647,070 SQUARE KILOMETRES. 5,000,000 INHABITANTS.

No definite opinion can as yet be formed concerning the deposits of mineral fuel of this country, which has only been explored from a botanical and not from a geological point of view. Dr. TIETZE, at least, has not yet published the results of his observations, and there is only a short communication on the above in Hochstetter's "Central Asia."

At a distance of about 114 kilometres north-west from Teheran a considerable *coal deposit* is found, cropping out near the village of Hif, south-east of Kaswin. It continues towards the capital, for a seam of it is found near Kent (23 kilometres from Teheran), and near Ferezat (15 kilometres). Afterwards it turns to the north behind the first range of the Elburz, appearing as a good

* T. G. KOHL, Die natürlichen Lockmittel des Völker-Verkehrs. Bremen, 1878.

deposit near Sheristanek, 38 kilometres to the north from Teheran; afterwards it turns towards the volcano of Pik Demawend, which has broken through the coal measures. Accordingly good coal is found in the adjacent villages, on the Laar river, and in Diwasia.

This Hif deposit is of great importance for the future on account of its situation, which is not only easily accessible, but also contiguous to the future line of railway from Tiflis *viâ* Täbris, Teheran, Shahrud, Meshed, Herat, and Cabul to India. The Hif coal has, however, already been worked for years, and the price of one chalvar (about 0·3 metric tons) at the pit's mouth is, in spite of the imperfect manner of working, only from 6s. to 6s. 7d.

A considerable number of coal seams is found in the same Elburz range, at a distance of 23 kilometres from Astrabad, on the caravan track to Shahrud. This coal may possibly become important to the navigation of the Caspian Sea when the forests of those parts will be exhausted.

Other coal-seams are existing near Kelat-Nadiri, in the vicinity of Meshed, and the rich lignite deposits of Ainal and Zainal are in the vicinity of Tabris. Lastly, coal is said to exist near Gerus in Kurdistan.

Owing to the difficulties of transport, there is, generally speaking, but a slight demand for coal in Persia; only the English inhabitants are induced, by force of habit, to have now and then some loads brought to their houses (by donkeys). The price in such cases is about 7d. per 50 kilometres.

As a matter of course, mining is carried on in the most unsystematic manner. A pit is made from which some tons are raised, and at a certain depth it is abandoned and another is started.

As the jurassic formation in Persia bears coal, there can be no doubt of coal existing in many places between Kaswin, Astrabad, and Meshed.

There are considerable deposits of excellent *iron-ores* in Persia, as, for instance, in the proximity of Kaswin, and chiefly in Masanderan; but, in consequence of the scarcity of fuel, iron is only produced at this one single place and not in considerable quantity. Comparatively little iron is used in Persia, as there are no railways, carriages, or factories existing there. Nearly the whole supply of iron is carried down the Wolga from the Ural to the ports in the Caspian Sea, from whence it is conveyed into the country by caravans. A good description of iron is delivered at these ports at 6½ karan per pud (16s. 8d. per metric cwt.) The import amounts to about 3,000 metric tons per annum. It is said that Russia has only a small profit on this business, which is only kept up by the works from want of orders.

Some British iron is also imported *viâ* Bushire and Bender Abbes, on the Persian Gulf. Iron wire, as well as all common descriptions of hardware, as locks, latches, nails, &c., come from Russia without exception. Tin-plate, of the value of £1,175 to £1,960 is imported from England; it is frequently used by the Persians instead of window-glass, stained windows having come into disuse on account of their cost; accordingly a very bright surface is the principal requirement, other qualities not being essential.

The greater part of steel comes from England or from Austro-Hungary *viâ* Trieste. During the last years the annual import consisted of 150 to 200 boxes, of the value of £780 to £980.

Arms are imported into Persia to the amount of £2,350 per annum, the greatest portion coming from England:*

For the manufacture of high-class *Damascus blades*, which is still feebly carried on at Shiraz and Meshed, some steel is imported from India, where it is manufactured for this special purpose.

Iron seems to have been very rare in Persia at the time of the reign of the Kaijonides, before Alexander the Great, because all the innumerable arrow-heads found in the vicinity of Persepolis are made of brass.

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* Dr. L. E. Polak, Officieller Ausstellungsbericht "Persien." Vienna, 1873.

# CENTRAL ASIA.

## 1,971,600 SQUARE KILOMETRES. 4,341,000 INHABITANTS.

In *Bochara*, a country still independent, large coal deposits of particular importance have been discovered lately.

The inhabitants of the *Karategin* Principality, which is situated in the Hindo-koosh district, but hitherto little known, are carrying on a brisk mining industry, and produce a first-rate description of iron.

The principal trade of the town of Faisabad in *Badakshan*, near to the outlet of the Dsher, in the country drained by the Koktsha river, is the manufacture of an excellent cast-iron hollow-ware, which according to all appearances has been introduced there from India.

*Coal* is mined in Aksu and Turfan, two provinces of *Eastern Turkestan*. That of the first-named district is said to be of a deep black colour, and of excellent quality; the Turfan coal being of a red-brown colour, and of inferior quality and low heating power, in consequence of the large amount of earthy substance and pyrites it contains.

The Aksu coal is said to be mined in the vicinity of Karabagh, and the Turfan coal in the Siukip hills near Ghotshang. The Turkish denomination of this mineral is tash-kumur or mineral charcoal. Coal is also reported to exist in the Kuen-Luen mountains, but the workings have been abandoned when the Chinese supremacy in these districts came to an end. Since that event nearly all industries formerly carried on in Kashgaria has been in a decaying condition. The Aksu and Turfan coal is collected by peasants and sold in the towns, but the present consumption falls far short of that during the Chinese supremacy. According to the most recent reports the Chinese have again taken possession of this district.

*Iron ores* are found in Eastern Turkestan, near the springs of the Shahuas river, and on the Kisil-Tagh and the Tumur-Tagh ("red mountain" and "iron mountain").

Large deposits of iron are also found in Bar-Roshan, on the Pandshah river, below Wamar. A mine in the Wamar valley, at 25 kilometres distance from the last mentioned town, yields ores of high percentage.

Only the Shahuas iron mines, in this district, are still in full activity. The ore is collected in the vicinity of Kisili, where from 400 to 500 families obtain a living by this occupation. The iron, which is said to be of excellent quality, is supplied to all the towns of the western portion of the country, where it is exclusively used, and also satisfies the home demand.*

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# THE EAST INDIES.

## 8,221,148 SQUARE KILOMETRES. 313,043,500 INHABITANTS.

Nearly all the Indian *coal deposits*† are situated in a region bordered in the north by the Ganges, and extending southward beyond the Godavery river. Their extent from east to west is from the country around Calcutta to the Nerbudda river. Only the coalfields of Kush-Bihar (in the Darjiling territories)

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* Ost-Turkestan und das Pamir-Plateau. Petermanns Mittheilungen, Gotha, 1877.

† Hochstetter, Asien, seine Zukunftsbahnen, und Kohlenschätze.

on the southern slope of the Himalayas, in the upper valley of the Tista river (a tributary of the Brahmaputra), and the Upper Assam coal deposits (in the Ditrugarh and Sibsagar district) are beyond this region.

The coal districts of this region are, according to Mr. BLANDFORD, to be divided into four groups: (1) Those of the Rajmahal hills and the Damuda valley (the principal group); (2) Those situated in Rewa, Sirguja, Choda Nagpore, Talchir on the Brahmani river, &c.; (3) That of the Nerbudda valley and of the Satpura hills; (4) The newly-discovered deposits in the Wardha and Godavery valleys.

In the *Rajmahal hills* small coalfields are found in every larger valley traversing the main range, with seams from 0·9 to 3·6 metres thick. The most important district, however, is that of *Raniganj* on the Damuda, to the south of the Ganges and the north-west of Calcutta, from which nearly the whole of the coal raised in India is obtained. In the year 1868 nearly 493,000 metric tons of coal were obtained there, the output of all other coal districts being only 40,000 metric tons. Since that time, however, the production has rapidly increased.

The coal deposits are first met at 192 kilometres distance to the north-west from Calcutta, extending to a length of 29 kilometres from north to south to a breadth of 64 kilometres, and their superficial area is equal to between 1,300 and 1,550 square kilometres. The seams are very numerous, and from 1·3 to 10·5 metres thick; their aggregate thickness amounting to from 30 to 36 metres. The quantity of coal available for working has been estimated at from 14,000 to 16,000 millions of metric tons.

The quality and also the appearance of this coal differ greatly from those of Europe. The main difference consists in the great quantity of shale it contains and the high percentage of ashes (from 10 to 30 per cent)—that of carbon being on the average 52 per cent and rarely more than 60 per cent—compared to which the average composition of English coal is 68 per cent of carbon and only 2·7 per cent of ashes. Indian coal accordingly possesses only from one to two-thirds of the heating power of English coal; and this country, the richest of all in natural resources generally speaking, is therefore, as far as is at present known, without good coal.

Some portions of these deposits were worked as far back as 1775. At present 44 mines, provided with 61 steam engines, are being worked—the most important of them being also provided with branch lines of railways.

The Bengal railways are at present using Raniganj coal exclusively, but the Madras and Bombay lines are still using English coal for their engines. The East Indian Railway Company possesses a number of coalmines, from which 800 metric tons per diem are being raised already, the greatest output realised by any company in India. The company uses about one-half of this quantity, and sells the rest, obtaining by these means a supply of coal at about one-eighth of the expense of other lines. The depth of the seams below surface averages 30 metres; at some places however open workings are carried on. The price of English coal in Calcutta is 39s. per metric ton, that of Indian coal 6s. 10d., a little over one-sixth. The entire output of native coal may at present be equal to four or five million metric tons.

The entire superficial area of the coal measures in the Damuda valley (the other coalfields of Iherria, Bokaro, Ramgarh, Karanpura, Kurhurbari, Deogarh, Chopé, and Itkuri included), is estimated at 4,000 square kilometres, one-half of this area covering workable seams of considerable thickness, and at a depth below the surface not exceeding 300 metres.

The *second group* of the Indian coal districts consists of a number of coal basins (Daltonganj, Risrampore, Talchir, &c.) scattered over an immense extent of the most uncultivated regions of India, which up to the present have not been sufficiently investigated.

The *third group* is situated in the Nerbudda Valley and in the Satpura Hills, by which it is bordered in the south. The seam, which is being worked at the Mopani works, is of 7·5 metres average thickness, and equal in quality to the Raniganj coal.

The *fourth group* is bordering on the extensive sandstone beds of the Godavery valley and of the lateral Wardha and Pranhita valleys, and extending from the vicinity of Nagpore to Ellore. According to the investigations made by Mr. BLANDFORD and Mr. HUGHES, workable seams exist in different places. An extensive seam of from 15 to 21 metres thickness has also been discovered in the Chanda district, in the Central Provinces, in Berar, and again in the Nizam territory. The deposits at the Wurrora works in the Chanda district are valued at 5,000,000 metric tons.

The *Upper Assam* coal is, according to Mr. MEDLICOTT, of a somewhat more recent age than the Damuda coal, and has as yet only been worked to a small extent. According to some samples taken from three different places it contains 53 to 61 per cent of carbon, 36 to 43 per cent of hydrogen and oxygen, and 1·7 to 3·7 per cent of ashes.

With regard to the geological age of the coal-bearing strata in India, the opinion was formerly prevalent that all of them were belonging to the same formation, which was considered identical with the Australian and not much differing from the European coal measures. Lately, however, it has been proved by Mr. HENRY F. BLANDFORD that the Indian coal-bearing strata are of greatly different ages, from the Permian to the Upper Jurassic formation. The strata of the Rajmahal group especially have been proved by Dr. O. FEISTMANTEL to belong to the Lias formation.

The natives scarcely ever burn coal, but use wood or dried cow-dung.

The quantity of English coal imported into the British possessions was :—

| | | £ Sterling. |
|---|---|---|
| In 1875 ..... | 625,190 metric tons, of a value of | 458,858 |
| In 1876 ..... | 772,013 „ „ „ | 456,763 |
| In 1877 ..... | 910,513 „ „ „ | 494,350 |

*Ironstone* mining is in some parts of India of very old date. KTESIAS, a Greek, living 400 years before Christ, mentioned Indian iron, and the swords made from it were greatly renowned.

Generally speaking, ironstone is even more frequently found in India than coal. But the natives are not skilful in smelting, and are making their wrought-iron by means of furnaces of the most primitive description. Only very recently some European companies have been formed for the purpose of utilising the mineral treasures of the country.

Enormous deposits of iron ores have been discovered near Madras, in the Salem district near Godumulay, at Karnul, Kadapeh, at Kunjamullay near Sooramunglam, and at various other places, but if they have been worked at all, it has been at any rate only to a very slight extent. The Madras ores are strongly magnetic; they contain 70 per cent of metallic iron, and are equal to the Swedish ores as to quality.

The Kunjamullay ore mountain is an extraordinary description of ore deposit; it is 120 metres high, and contains many seams of magnetic ore, up to 30 metres thick, which are perceptible from afar.

The part of the Gondmana country in Hindostan, extending over 8,110 square kilometres, which is surrounded by the Kurrukpore mountains, the Ganges, and the Rajmahal mountains, contains iron ores as well as coal. The ores are smelted in the Kurrukpore mountains, in blast-furnaces of a primitive construction.

Rich ore deposits are also found in Nepaul, in the Himalaya mountains; they are owned by the Maharajah, who allows them to be worked without proper care, and studiously keeps away foreign enterprise.

The first beginnings of an important iron industry have long existed in India, but all undertakings decayed after some time—probably from want of support on the part of England—and at present only the ruins of furnaces, which have been in blast for some time, are to be found.

In spite of the enormous coal deposits of the country, and the consequent favourable conditions for manufacturing iron, the quantity of iron actually produced is insignificant compared to the import from England, which in 1874 was equal to £1,772,848, and in 1875 to £1,638,506. The home production is confined to a small quantity of iron and steel, made from the ores direct by one of the most primitive processes.

The only product deserving to be mentioned is the renowned Indian steel known by the name of "wootz." It is produced by cutting wrought-iron into small pieces, which are exposed to an adequate heat in small crucibles, together with about 10 per cent of dried chips of the wood of *Cassia auriculata* and some green leaves of *Asclepias gigantea* or *Convolvulus laurifolia*. No explanation of the excellent qualities of this steel has as yet been afforded by chemical analysis. Wootz steel is manufactured only in a few districts of Mysore, and at Salem in Madras.

The armour manufactured in India—chiefly the scale and mail jackets—is of rare beauty, and by far surpassing anything of this kind made in Circassia, Kurdistan, Japan, and the Sudan districts. The great renown of Rangoon, Gwalior, Vizianagram, Nellemasla, Sealkote, and Goojerat is chiefly due to their excellent armourers.

It is confidently expected that both the Indian coal and iron trades will be largely extended in a short time, and that a change to a state more befitting the wants of the age will be effected by the introduction of iron manufacture by coal and coke. The endeavours of the Bengal Ironworks Company, by which ironworks have been erected in the Burrakore district, 160 kilometres from Calcutta, are especially worth mentioning. Ores are melted there in two large blast furnaces by coal which is mined in the immediate vicinity, and which has also proved very suitable for coking. Not far from there the Bengal Coal Company has erected two other furnaces, with a daily production of 25 tons of pig-iron. Here the ores are everywhere cropping out at the surface, and coal-mining is also carried on without any difficulty.

The Wardha valley, in the territory of the Central Provinces, seems to be of good promise for future enterprise in the coal and iron trade. It is expected to become the Indian "Black Country."

At the end of 1877, Hindostan possessed a railway system of 11,164 kilometres, to which 146 kilometres completed in Ceylon are to be added.

## BURMAH, SIAM, AND ANAM.

These countries are well provided with iron, but less so with coal, workable coal seams having been discovered only in Burmah, and lately in Tonquin. The excellent coal deposits in *British Burmah* are situated near Kjuk-phju. Iron ores are found on Ramri and Tsheduba, but mining operations would not be remunerative, on account of the competition of the imported British iron. In *Tonquin* iron ores and coal seams are cropping out at the surface close to each other, and a portion of them, being also close to the sea-shore, could easily be worked.

## INDIAN ARCHIPELAGO.

In *Java*—the principal Dutch colony in this Archipelago—coal is borne by the aqueous formations in different localities. Coal seams, which could possibly be worked with profit, are only found in the eastern parts of South Bantam, where quartzeous, not calcareous, sandstone predominates. They are confined

to a narrow mountain district, containing a pure and hard glance-coal, with a large percentage of carbon, and bearing more resemblance to proper coal than lignite. The Bantam seams are nearly all of the same description. Their coal has a shining surface, and is highly bituminous. They were discovered in 1826, by the botanist SPANOGHE..

Promising coal seams have been discovered quite recently in some newly-made railway cuttings, and competent men have been sent by Government for investigation.

In 1875 Java purchased from England 72,952 metric tons of coal, and 1,297 metric tons of coke, worth £53,587 and £1,542 respectively.

Ores of all descriptions, especially magnetic, brown, and titanic ores, are very scarce in the mountains of Java. The length of the railway lines completed in this island is already 260 kilometres.

*Sumatra* possesses on its western coast rich coal deposits. On the island of *Borneo* there are—together with an enormous subterranean wealth of gold, copper and iron veins—also inexhaustible coal deposits, chiefly in Brunai, on the British island of Labuan, close to the north-western coast of Borneo, and in Banjermassing. It can be worked easily, but only very little of it is being raised. Iron is found in extraordinary quantities in Borneo, chiefly in the southern portion. It is used by the natives for making their excellent blades; but owing to the scarcity of hands, and still more so to that of capital, these treasures will for a long time remain hidden in the earth, without being made serviceable and useful to man. Also on the island of Billiton, between Borneo and Banka, excellent iron ores have been found, and workings have been commenced of late.

Many islands of this Archipelago are provided with coal from the *Philippine Islands*. Here the first rank is taken by the Island of Cebu, where coal has been mined for some time surpassing in quality that of Labuan and of Australia, which are now imported into the British possessions in China (Hongkong). The Cebu coal, which is sold at a price of 4s. per metric ton (the price of English coal in Manilla being 12s. to 13s. 6d., and the import in 1875 10,466 metric tons, of the value of £7,364), contains on the average 46·16 per cent of carbon, 42 per cent of water and gaseous compounds, and 11·84 per cent of ashes. The rich lignite deposits of Caramuan, on the main island of Luzon, are also deserving consideration. Iron ores are likewise plentiful on the different Philippine islands.

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# THE CHINESE EMPIRE.*

## 10,290,600 SQUARE KILOMETRES. 433,694,000 INHABITANTS.

CHINA is in possession of coal deposits which are by far the largest of the Asiatic continent.

All the eighteen provinces of the Empire, and Southern Manchuria besides, are well provided with coal, and however the extent of the coalfields and the age and quality of their contents may differ, China may even now be called one of the richest coal countries of the world.

The date of the first beginnings of coalmining in China is unknown, but it certainly is a very early one, because MARCO POLO noticed already in the thirteenth century an extensive local use of coal called "Mei" by the Chinese.

* HOCHSTETTER'S "Asien und seine Kohlenschätze" and VON RICHTHOFEN'S most important publications have been made use of.

It has been proved that coal has been used in China as early as in the third century before Christ. Notwithstanding this, the coal is at present got in the same primitive manner as hundreds or thousands of years ago. Drifts are worked into the hillside, and as soon as water is encountered the mine is abandoned. As late as 1876 the first steam engines are said to have been erected at some coalmines in the vicinity of Pekin, and thus a new era in Chinese coalmining has been initiated.

Steam navigation along the Chinese coast and on the Chinese rivers is, as a matter of course, almost exclusively carried on at present by means of foreign coal, which is imported from England, the United States, Australia, Japan, and Formosa, by way of the ports of Hong-kong and Shanghai. In 1875 the import of English coal into China (inclusive of Hong-kong) amounted to 59,332 metric tons, of a value of £46,484, and that of coke to 1,529 metric tons, of a value of £2,867. The prices of coal delivered at Shanghai have been averaging during the last years as follows: Cardiff coal, 24s. per ton; American anthracite, 24s. to 26s.; Australian (chiefly Newcastle) coal, 20s.; Japanese hard (anthracite) coal, 12s.; ditto soft (bituminous) coal, 12s.; Formosa coal, 12s. per ton.

The import duty for foreign coal has been fixed by treaty at 5 candarines per ton, native coal exported being subject to the much higher duty of 4 candarines per picul (17·40 piculs=1 ton); and if coal is conveyed from one Chinese port to another it is taxed at 6 candarines per picul, according to the coast trade regulations.

This state of things is clearly very disadvantageous to the native coal trade, and it may be justly said that under present circumstances the conveyance of Chinese coal from one port to another on board of European vessels is prohibited.

Any body who likes may work a coal seam. The price of coal, however, is raised by a number of go-betweens and by the high costs of carriage to such an extent that English coal is cheaper in seaport towns than native. Accordingly vessels are still making a profit in taking a cargo of coal from Europe; but of late Japanese coal has entered into competition. The Government, however, does not in any way appreciate the value of this material. The use of coal for domestic purposes is chiefly confined to the northern provinces, and rather avoided by the inhabitants of the southern parts.

The mountain range of the Tsing-ling-shan,* up to 3,300 metres high, is the watershed between the Yang-tse-kiang and the Hwang-ho valleys. It consists of granite, crystalline schists, and other rocks of the oldest formations, and as a continuation of the Kwen-lun in central Asia extends eastwards into China like an enormous wedge, separating the North of China from the South, the valleys of the "Yellow River," the Hwang-ho, from that of the Yang-tse, or the districts mostly covered by "loess" (fluviatile loam) from those more or less devoid of this peculiar formation of North China.

*The Southern Coalfields.*—In the provinces to the south of the watershed between the Hwang-ho and the Yang-tse, which are comprising the regions of the lower and the middle Yang-tse, the coal-bearing strata are scarcely less in extent than those in the northern and north-eastern provinces; nevertheless they are not of the same importance, the Hoo-nan deposit excepted.

The coalfield of the province of *Se-chuen—i.e.*, "the country of the four rivers"—which is entirely surrounded by high mountain ranges (belonging in the east to the silurian and Devonian, and in the west to the metamorphic formation), is comparatively the largest, and, according to VON RICHTHOFEN, covers at least 250,000 square kilometres. The coal seams are cropping out in the deeply-indented valleys of the rivers bordering the coalfield, and are being worked. The coal of the western and northern portions of this district is bituminous and of a better

* The main range, erroneously named Pe-ling in our charts, has different names for different portions. The highest part is, after one of the most important passes, named Tsing-ling-shan.

quality, that of the southern and eastern parts being an inferior description of anthracite. An exportation of this coal to the country of the lower Yang-tse-kiang cannot be thought of; but the inhabitants of the extensive province of Se-chuen may be easily provided with a cheap fuel from this district, as nearly all rivers of the province are navigable from their outlet into the Yang-tse up to the borders of the coalfield. The northern portion of the province of *Quei-chow* is also extending into the Se-chuen coalfield; and in *Yun-nan* too, the south-western border-province of China, towards India, extensive and thick seams of good anthracite are found in proximity to copper, tin, zinc, and lead ores, affording the fundamental conditions for an active and extensive mining and metal industry. The coal deposits of Se-chuen, Quei-chow, and Yun-nan, according to Baron von Richthofen, do not belong to the coal measures proper, but to the Trias or to the Lias formation. Accordingly they would be of the same age as the Indian coal seams.

The coal measures proper are found, however, in the eastern parts of Southern China, principally in the province of *Hoo-nan;* but beyond this province, only in a number of small and separated districts of the maritime provinces. Amongst these the Chow-choo-foo deposit in *Quang-tung* might possibly be of some use to Canton and Hong-kong if more extensively worked; but the coal is of an inferior quality, and the available quantity of it is inconsiderable. The same applies to the other deposits.

The province of Hoo-nan is far better off, and up to a few years ago this was the only province fairly renowned for the abundance of its coal deposits, as an entire fleet of boats carrying coal from Hoo-nan is continually plying on the Yang-tse and its tributaries. The three towns of Woo-chang, Han-kow, and Han-yang, on the outlet of the Han-kiang into the Yang-tse, containing a million and a half of inhabitants, and the dense rural population of the province of Hoo-pe, are supplied with mineral fuel exclusively from Hoo-nan.

The coal deposits are situated in the south-eastern part of the province. Richthofen, who, in 1870, paid a visit to the Hoo-nan coalfields, has estimated their extent at one-third of the entire area of the province, or at 47,300 square kilometres, and therefore it is equal in area to the Pennsylvanian coalfields. They extend on each side of the Siang river, from its source down to the town of Siang-tan, containing one million of inhabitants; their southern portion—the Lui river district—is yielding an excellent anthracite, called hard coal; that of the northern portion—the Siang river district—being bituminous, or soft coal. Upon these mines an iron industry of limited extent is dependent.

The Hoo-nan coal district is able to supply a great portion of Central China with fuel; but as long as it is not connected with Canton by a railway line the seaport towns will not be benefited by it, being supplied at a cheaper rate from the northern provinces of Shan-se and Shan-tung. The best Lui-yang anthracite can be delivered at Han-kow (693 kilometres) at 7s. 2½d. per ton. The seams are from 0·9 to 1·8 metres thick, and the production amounted to 147,000 tons in the year 1870.*

*The Northern Coalfields.*—In the northern portion of China, the area drained by the "Yellow River," our attention is attracted immediately by the enormous coal deposits in both the provinces of Shan-se and Shen-se, extending westward up to the desert districts of Central Asia, north-eastwards to Manchuria and the frontiers of Corea. The provinces partaking of these deposits are in the east, on the shores of the Yellow Sea, the provinces of Shan-tung and Che-lee; in the north-east Chin-kiang, or Leao-tung, and Manchuria; in the centre Shan-se

* The coal deposits of the lower Yang-tse-kiang, between Wa-chang and Nankin, are, according to Richthofen, of no importance. Respecting other deposits, in the maritime provinces of To-kien and Che-kiang, we only possess reports of an unreliable character, made by missionaries. When MARGARY was travelling across China, in 1875, he saw, near Ching-ping-hsien, coal exhibited for sale, from which he supposed coalmines to exist in the neighbourhood.

and Shen-se; in the south Ho-nan, and in the west Kan-su. This entire territory, bounded in the south by the Tsing-ling-shan and Foo-niu-shan ranges, in the north by the slopes of the Mongolia tableland, and in the east partly by the sea, partly by the extensive valleys of the Yellow River and the Pei-ho—a territory extending from Kan-su in the west to the Corean frontier over 25° longitude—may be considered as one immense coalfield, in spite of the unequal quality of the coal scattered over an area of this extent, and of the separation of the strata into different basins, consequent of the partial denudation of the seams. The remainder of these coal deposits of North China, together with the Se-chuen and Hoo-nan deposits, are large enough to be compared to the most extensive coalfields of the world hitherto known—those of North America.

The province of *Shan-se* may be called the principal iron as well as coal district of China. In no other province has coal been so prominently used from the most remote ages for domestic and industrial purposes. The greater portion of the southern half of this province has been proved by Baron von Richthofen to be a continuous coalfield of 91,000 square kilometres area and of enormous thickness, offering facilities to mining enterprise such as are not afforded by any other coal district of similar extent. Richthofen is of opinion that if it were situated in Europe the progress of our continent would be increased immensely. Near these coal deposits a great abundance of excellent iron ores is also found.

The Ho-shan, a mountain range consisting principally of gneiss, and extending from north to south at a maximum height of 2,400 metres, is dividing this coalfield into two portions, of which the eastern one is exclusively yielding anthracite; the western one, extending towards the Yellow River, bituminous coal only. The anthracite district, extending without interruption from Tse-chow-foo to Ping-ling-chow, is the most extensive and the richest of all coalfields known, and its contents are of the very best quality. One of the seams cropping out along the slope of the Tai-hang-shan, with some interruptions, for a for a length of 320 kilometres, is of an equal thickness of 6 to 9 metres. The anthracite, which is of great cohesive strength and purity, is quarried in large cubical pieces, which are sold by several mines at 6d. per ton. The price of bituminous coal in the western portion is still lower. Near Tai-yuen-foo it does not exceed 3d. to 4d. per ton. No better proof of the abundance of coal and of the facilities for mining operations could be given than these figures.

The province of *Ho-nan* shares to a certain degree the advantages enjoyed by the province of Shan-se, and although less favoured by nature in the extent of its coal district, Ho-nan is superior to the neighbouring provinces in regard to its geographical situation. In consequence of a fault occurring in the seams at the juncture of the Shan-se tableland with the valley of the Yellow River, the anthracite seams of eastern Shan-se are reappearing in the low hills, rising northward of the Hwang-ho, above the plain of Hoai-king-foo, and are worked there on a rather extensive scale at over 100 mines. The Ho-nan coalfield will no doubt become of great importance in future, being situated at one of the inlets of traffic between China and Central Asia.

There are other coal deposits in Ho-nan of less importance. The most extensive of them is that of Loo-chow and Joo-chow, yielding a good bituminous coal, from seams of 1·4 to 2·8 metres thickness. This deposit may become important in future times, as an important railway line connecting eventually the Han Valley with the Yellow River country, will be supplied with coal from it, and as its coal would serve for smelting the iron ores which are found there in close proximity.

The province of *Shen-se* contains a part of the south-western elongation of the western portion of the great Shan-se coalfield. But in spite of the coal measures predominating to all appearance over all other formations, the seams there will most likely prove to be less suitable for mining. Coal is being mined at several places, but it is nowhere of more than local importance.

The province of *Kan-su*, however, is, according to the information gathered by Richthofen in the border territories, enjoying the twofold advantage of favourable conditions for mining operations and of an extensive market, several of its mining districts being favourably situated for supplying the present as well as the future roads of intercommunication with fuel. The coal is said to be at least equal to the best Shan-se coal, and is found in seams of considerable thickness.

Amongst the numerous and extensive coalfields of a more recent geological age, extending with frequent interruptions north-westward of the large Shan-se coalfield in the northern portion of the province along its north-western frontier and the Great Wall, the Tatung-foo coalfield is the most important. The geological structure and the thickness of the seams (seven metres in some places), the quality of the coal, which is a first-class anthracite—in short, all natural conditions—are exceedingly favourable here. This coalfield belongs, according to Richthofen, to the Rhaetic (Penarth) beds.

In the neighbourhood of *Pekin*, the present capital of the empire, anthracite of medium quality is mined. It constitutes the fuel chiefly used in that city, and is conveyed to it by camels and donkeys. Some of the mines are in the northern and western border hills of the Pekin plain (as, for instance, in the valley of Tshai-tang, 80 kilometres westward of Pekin), but most of them are in the higher districts and in localities difficult of access. Besides these there is a great number of smaller coalfields belonging to the Lias or Trias formation in the province of *Che-lee*, partly in its western portion, in the country between Pekin and the tableland of Mongolia, partly in the eastern portion nearer to the sea. The Kai-ping coalfield in the Ching-shan hills, a solitary group arising from the alluvial plain at 128 kilometres distance to the east from Tien-tsin, deserves especial mention on account of its advantageous situation; and the Shi-men-tsai district, a locality not far from the spot where the Great Wall reaches the sea, is noted for the good quality of its anthracite.

The beautiful province of *Shan-tung* contains (according to Richthofen) coalfields which in future will become of more importance to the seaports and ocean navigation than any other. The coal seams are found at the foot of the hills in the western portion of the province near to the coast, which, however, is unfortunately without any harbour. The surface of the district is of such a configuration, and the density of the population so considerable, that no more favourable conditions for the construction of a railway could possibly be desired.*

Lastly, there are coalmines in different localities of *Ching-king* or Southern Manchuria, some of them being near to the coast and to fairly good harbours like Che-foo, where considerable quantities of coal are consumed accordingly. Others are situated between the Liao river and Corea. The extent of the coal measures being, however, inconsiderable, all these deposits are rather unimportant.

We are thus convinced by Richthofen's investigations that in respect of abundance of mineral fuel the Celestial Empire is one of the most favoured countries in the world. According to all appearances the area of the Chinese coalfields exceeds even that of North America. As far as the geological structure of the seams and their quality and quantity are concerned, no coalfield of the world can be compared to that of Shan-se, which Richthofen terms "gigantic," and which contains an anthracite of unrivalled heating power and commercial value. It is Richthofen's opinion that at no other place do such facilities for working cheaply, easily, and extensively a deposit of excellent coal exist as here,

* The Tien-tsin merchants have been for a long time endeavouring to have these coalfields opened according to European notions. They intended to construct roads to facilitate the transport of coal to Tien-tsin. The owners of the land were willing, too, to give up as much of it as was wanted for a compensation, but the Government refused permission. In consequence of this, the steamers plying between Shanghai and Tien-tsin are obliged to purchase British coal at £1 3s. 6d. per ton instead of the native coal, which could be delivered at exactly half of this price.

where engine drifts might be worked for miles along the coal and anthracite seams, by which extensive beds of ironstone and clay would be opened at the same time. From these, China has been supplied with iron from the most remote ages. The anthracite basin of Southern Shan-se is so rich that an output of 300,000,000 tons per annum—sufficient for the actual demand of the entire world—would be available from it for 2,400 years!

The mining industry of China is, however, quite in its infancy yet. In spite of all these favourable conditions, the actual output is only the fifteenth part of that of Germany or the United States. According to Richthofen's calculations it is equal to about 3,000,000 metric tons, viz.;—

| | Metric Tons. |
|---|---|
| Province of Shan-se (anthracite) | 1,000,000 |
| " " (bituminous coal) | 700,000 |
| " Hoo-nan (all descriptions of coal) | 600,000 |
| Lo-ping Coalfield, in Kiang-si | 75,000 |
| Remaining portion of Kiang-si, and the Provinces of Kwang-si, Quang-tung, Fo-kien, Che-kiang, Kiang-su, Nyan-whei, Hoo-pe, and Quei-chow (total) | 20,000 |
| Tsing-wha District, in Ho-nan | 60,000 |
| Remaining portion of Ho-nan | 40,000 |
| Provinces of Se-chuen and Yun-nan | 50,000 |
| " Shen-se and Kan-su | 40,000 |
| Province of Shan-tung | 200,000 |
| " Che-lee | 150,000 |
| " Ching-king (Southern Manchuria) | 20,000 |
| Total | 2,965,000 |

or about 3,000,000 metric tons for the eighteen provinces of the empire and Southern Manchuria.* From a more accurate statistical return a somewhat larger figure would most likely be obtained.

The average daily wages of the miners are 6d. to 7d.; the price paid for a ton of best anthracite at the pit's mouth varies, according to the prime costs, from 6d. to 4s. 5d. The cost of transport frequently amounts to fifteen times the price of coal; carriage to a distance is generally speaking out of question.

It is Richthofen's opinion that the production of coal in China will presently be much increased. If the Chinese were only willing, important centres of production might be constituted in a short time in the vicinity of the coalfields, as such quantities of cheap fuel and skilled and efficient labour are found side by side in no other country of the world as there.

When describing the coalfields we mentioned that considerable iron ore deposits had been discovered in connection with the coal, as, for instance, in the provinces of Shan-se, Ho-nan, Yun-nan, and Se-chuen. Iron ores are also widely dispersed all over the other provinces of China. A great number of people are employed in ironworks, chiefly in those of Shan-se, but the manner in which mining and smelting operations are carried on is still exceedingly simple and primitive. Real blast furnaces and other appliances for working iron and steel, and befitting the general state of our age, can hardly be found anywhere in China. The existing ironworks are certainly of the most primitive description.

A coalfield of small extent has been discovered on the northern coast of the island of *Formosa*, near the sea-ports of Ki-lung, Nuan-nuan, and Sio-con, in the Tamsui district, which is under Chinese supremacy. Mining operations are carried on by the Chinese colonists in Formosa in a most primitive way. Wherever a seam crops out at the hillside or from the configuration of the strata

* F. von Richthofen: Die gegenwärtige Kohlen-Production in China und die voraussichtlichen Folgen ihrer zukünftlichen Entwickelung. Oesterr. Monatsschrift für den Orient. 1878. No. 1.

is supposed to exist, a heading is worked, either horizontally or with a slight slope, to cause the water to run off. These headings are up to 6 metres high at the opening, and are carried forward as far as 90 to 450 metres. At the end they are generally so low, as to be only accessible by creeping. The coal is carried out in baskets; a pick and a basket are accordingly the only implements wanted by a Chinese collier. Fire-damp seems to be unknown in the Formosa mines. In 1875 the Chinese had already opened 192 workings, and had made a good profit from them.

These coalmines of northern Formosa are of great importance on account of the quality of their coal, which is generally a very serviceable fuel, and prominently so if mixed with English coal. The merchant steamers are consequently already in the habit of putting into Ki-lung for the purpose of coaling. The coal is a tertiary lignite; it burns freely and gives a considerable heat. Although the Chinese authorities do everything in their power to restrict the production, the export of coal from the two northern ports of Tamsui and Ki-lung increased from 14,730 metric tons in 1869 to 45,177 metric tons in 1873. As soon as these rich deposits can be worked according to rational methods, and the high duties have been reduced, the importance of Formosa coal for the East Asiatic trade will be fully recognised, and it will doubtless be exported in large quantities.

The price of this coal delivered at Shanghai is 11s. 7d. per metric ton. The production, which in 1871 was 18,790 metric tons, increased in the following year to 75,000 tons. No returns of more recent date are at hand.

Another extensive deposit of fairly serviceable coal has been discovered in the northern parts, near Takow, by the United States squadron, under Commodore PERRY.

Large quantities of *iron* are said to be produced in Formosa.

It will be remembered that the first railway in China, the Woosung-Shanghai line, only 13 kilometres long, was opened on June 30th, 1876, and in a short time carried on a very brisk traffic. In 1877 this line was purchased on the part of the Chinese government, and, to the astonishment of the Europeans, torn up again instead of being further extended.

Under such circumstances a Chinese railway system is indeed a far distant vision. The realisation of Richthofen's grand project of connecting the Ili valley in central Asia, which has lately come into the possession of Russia, and the Chinese provinces on the Yellow Sea by a railway line, will have to be deferred for some time. It is a singular coincidence that the whole length of this future railway extends through districts well supplied with coal.

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# JAPAN.

## 407,772 SQUARE KILOMETRES, 33,299,014 INHABITANTS.

THE numerous and important coal deposits of Japan may safely be said to constitute the greatest mineral wealth of that country, although up to the present they have been insufficiently investigated, and are worked in a very primitive way. Apart from peat there exists not only lignite but also coal suitable for coking and of the description known as open burning, as well as anthracite and graphite. Lignite is found in 16 districts (Ken), coal in 11, and anthracite in 2 districts of this insular empire. In the remaining "Kens" the existence of mineral fuel has been proved, but detailed information about its quality has not been given.

Some idea of the area and the contents of the most important Japanese coal basins may be obtained from the following table:—

| Island of | Coal Basin. | Area in Square Kilomtrs | No. of Workable Seams. | Thickness of Seams. | Thickness of Coal. | Description of Coal. |
|---|---|---|---|---|---|---|
| | | | | Metres. | | |
| Yesso .. | Ishikari, Upper Seams .. | 1553·9 | 6—12 | 0·6—5·8 | 13·7 | Bituminous, open and close burning. |
| ,, | Ishikari, Lower Seams .. | 6215·7 | 4 | 0·6—1·2 | 3·0 | Bituminous, open burning. |
| ,, | Kanyanoma ..... | 2·6 | 12 | 0·6—2·3 | 15·2 | Bituminous, open and close burning. |
| ,, | Akkeshi ..... | .. | 4 | 0·6—0·9 | 3·0 | Bituminous, open burning. |
| Niphon | Iwaki ..... | 517·9 | 2 | 1·4—1·8 | 3·0 | Bituminous, open burning. |
| ,, | Niigata..... | .. | .. | .. | .. | Bituminous, open burning. |
| ,, | Kii..... | .. | .. | .. | .. | Anthracite. |
| Sikok .. | Awa ..... | 517·9 | .. | .. | .. | Bituminous, open and close burning. |
| Kiusiu | Chikuzen..... | 776·9 | .. | .. | .. | Bituminous, open burning. |
| ,, | Karatsu, Upper Seams .. | 906·5 | 3 | 0·9—1·2 | 3·0 | Bituminous, open and close burning. |
| ,, | Karatsu, Lower Seams .. | | 10 | 0·3—0·6 | 4·6 | Bituminous, open burning. |
| ,, | Nangasaki, inclusive of Takashima, and other islands in Nangasaki Harbour ..... | 5·2 | 13 | 0·9—4·9 | 15·2 | Bituminous, close burning. |
| ,, | Miike ..... | 64·7 | 3 | 1·2—2·4 | 4·6 | Bituminous, close burning. |
| ,, | Amakusa..... | 25·9 | 2 | 0·6—0·9 | 1·5 | Anthracite. |

If we add to these figures the area of the basins which have not been investigated at all, the total area of the Japanese coalfields may be approximately set down as 13,000 square kilometres. The average thickness of coal may be taken as 4·5 metres.

The most important of all the coalfields are doubtless those of the island of Yesso, and although they are but imperfectly known a great future may safely be predicted for them. At the present time the Takashima coal, of which something more is to be said afterwards, is of the most importance.

A description of all the coal districts of this insular empire is contained in the excellent work on the mineral wealth of Japan, written by Mr. HENRY S. MUNROE, professor of mining and geology at the Imperial University of Tokio (Yeddo), and translated into French by M. LEON THONARD, mining engineer in Liége, 1877.

Until now the Japanese have not been able to sink shafts to any considerable depths, and, consequently, they have been mining coal and metals only at the outcrops. But as soon as they shall have acquired experience in sinking shafts they will turn the numerous ore and coal deposits which are scattered all over the country to good account, without foreign assistance.

The following is a table of the production of coal in Japan during the year 1874 :—

| | Metric Tons. |
|---|---|
| Island of Takashima, in Nangasaki harbour..... | 73,589 |
| Miike basin ..... | 67,385 |
| Imabuku district, Karatsu basin ..... | 33,088 |
| Taku ,, ,, ,, ..... | 22,553 |
| Karatsu ,, ,, ,, ..... | 59,221 |
| Hirado ,, ,, ,, ..... | 64,171 |
| Other parts of Japan, according to estimate ..... | 76,233 |
| Total ..... | 396,240 |

Accordingly, the production has been trebled since 1871, at which time it was 112,369 metric tons; and it is likely to have increased at an equal rate during the last three years.

A great portion of it is raised in the Nangasaki district, a mine having been opened there about the year 1870, on an island not far from that town, which afterwards was leased to Messrs. Glover and Co., an English firm. Such proceedings were until then strictly prohibited by the Japanese, as well as the Chinese. But the former have, by retracting this prohibition, made the first steps towards an enterprise which will be of great service to the steam navigation and metal industry, and by which the public revenue will be considerably increased as well. In the year 1868 there were exported from Nangasaki only 10,348 metric tons of coal, but in 1872 the quantity had risen to 139,700 metric tons. In 1876 the entire output at the Nangasaki mines exceeded 200,000 metric tons, about 600 metric tons being raised daily. The total number of people employed there during day and night was 4,000. The wages, cost of carriage, and maintenance amounted to £980 per month; accordingly the owners of the mine seem to make a fairly good profit, as the coal realises a high price in China and Japan. The above figures give evidence of a rapid progress, but even supposing the coal traffic would increase in the same proportion all over the country, no apprehension need be entertained as to a speedy exhaustion of the resources of Japan. Not only are the existing mines capable of yielding a much greater output under experienced management, but an immense number of seams of more or less thickness, which as yet have not been opened by mining enterprise, are known to exist.

As a proof of the deficient method of working the seams, to which we formerly alluded,* we may state that a mine generally consists of a single main drift 47 inches wide and 39 inches high, with headings 35 inches high and 30 feet long. No precaution of any description is taken against accidents. The workings are lighted by open oil lamps. The roof, being without props, may tumble down at any time. The getting is performed in the same lax manner. The miners use small crowbars and picks; the coal which has been hewn is thrown into bamboo baskets provided with slides, and fitting into a timber slip-way—an appliance corresponding to our railways. Lads, twelve to fourteen years old, are yoked to the baskets to draw them to the mouth of the pit. The ventilation is abominable; and the pumping arrangements primitive in the highest degree. On the pit-brow the coal is treated in the same manner as below ground. The baskets are emptied at the mouth of the pit, and their contents packed piecemeal on rude cars, which are dragged by men to the bank of the river, which is generally not far off. There they are emptied again, and the coal is filled in small baskets, and carried on board the boat. In this laborious manner of working the low price of 6s. 10d. per metric ton of Japanese coal is raised to more than 7s. 10d. on the average. In spite of all this, it may safely be predicted that the whole of eastern Asia will, sooner or later, be supplied with fuel from Japan.

The chief shortcoming of Japanese legislation, already alluded to, consisted in the exclusion of foreign capital from Japanese mining concerns. A foreigner was neither allowed to be part-owner of a mine, nor to lend money on mortgage of mining property. A mighty impulse will be given to mining enterprise by the abolition of these preventive enactments, which in fact has already taken place.

The following analyses of Japanese coal will be of some interest:—

* L. Katscher, Das Mineralreich Japans. Globus, vol. xxxi.

| | Sorachi Kayanowa basin, Yesso. | Karatsu. | Takashima, Nangasaki Harbour. | Miike Gas Coal. | Average of 12 descriptions of Japanese Coal. |
|---|---|---|---|---|---|
| Water | 2·9 | 2·7 | 1·8 | 0·5 | 4·6 |
| Carbon | 77·0 | 69·4 | 78·6 | 69·3 | 67·6 |
| Hydrogen | 5·7 | 5·2 | 5·8 | 5·5 | 5·0 |
| Oxygen and Nitrogen | 11·0 | 11·9 | 8·7 | 4·9 | 10·8 |
| Sulphur | 0·6 | 1·2 | 0·7 | 3·5 | 1·6 |
| Other mineral compounds | 2·8 | 1·6 | 4·9 | 16·3 | 10·4 |
| Total | 100·0 | 100·0 | 100·0 | 100·0 | 100·0 |
| Hydrocarbonates | 11·0 | 12·1 | 8·5 | 4·1 | 10·8 |
| Hydrogen (free) | 4·5 | 3·8 | 4·9 | 5·1 | 3·8 |
| Caloric units | 7,782 | 6,927 | 8,035 | 7,342 | 6,764 |
| Weight of water evaporated by unit of weight of coal | 14·0 | 12·4 | 14·4 | 13·2 | 12·1 |
| Temperature of combustion | 2,627°C. | 2,581°C. | 2,644°C. | 2,615°C. | 2,566°C. |

The Japanese insular empire is abundantly provided with *iron*, but the quantity produced is very insignificant. It is stated to have been 5,089 metric tons in 1874, against 9,375 metric tons in 1871. This insignificant production of iron and steel is chiefly obtained from magnetic ore sand, which is found in the alluvial deposits, principally in the island of Yesso, and purified by washing—rarely from magnetic and hematite ironstones of other parts of the country. The magnetic ore sand is very fine grained, and generally washed so well as to contain 60 per cent and more of pure iron. It is supposed to have a slight admixture of titanium. It is smelted by charcoal in small furnaces, the quality of the product obtained in this manner being of course very variable.

For the production of castings English pig-iron is imported. The greatest part of the charcoal used is made from oak, and is of excellent quality. These castings are mostly objects of domestic use, as pots, pans, shovels, &c., which are executed in a very creditable manner.

Until lately engine power was never applied to iron manufacture; all iron was forged by hand. The iron is of fine quality, and the iron and steel tools are of good workmanship.

A very extensive and rich deposit of iron ore from 2·4 to 5·4 metres thick exists at Naka-kosaka, near Tokio (Yeddo), in the province of Hitachi. Two English engineers have been erecting a charcoal blast furnace there for a Japanese company, which was blown in in March, 1876.

Another important ore deposit has been discovered at Heigori, near Riklishiu. Magnetic ore containing 60 per cent of pure iron is found there in a seam of from 3·6 to 4·5 metres thickness. The Japanese Government has erected two charcoal blast furnaces here, and also a rolling mill, working with 12 puddling and 7 heating furnaces, a steam hammer, and other requisite appliances of the latest date.

A large engineering establishment, the first in the empire, was in course of erection in 1877.

Iron ores were also mined on the island of Yesso, but most of the mines have been stopped by the Government on account of the work not being profitable. The sand of the southern beach of Vulcan Bay and near Cape Tson contains much iron, which is worked near Nedanai.

The length of Japanese railways was 105 kilometres at the end of 1877. The first line, from Yokohama to Yeddo, was opened on the 12th of June, 1872.

# AFRICA.

29,932,948 SQUARE KILOMETRES. 199,921,600 INHABITANTS.

AFRICA is, no doubt, the part of the world upon which the smallest portion of mineral wealth, in the shape of coal, has been bestowed. It must decidedly be described as poor in coal. Certainly, even the best known districts of it have been but very insufficiently investigated from a geological point of view; and there are vast tracts of land in its equatorial regions which are entirely unknown in every respect. But the existence of only a moderate amount of mineral fuel would have been conducive to a discovery of more coal deposits than those known at present.

It seems however to be somewhat better provided with iron. Numerous native tribes in this part of the world were proficient in the art of casting and forging iron in the most remote ages. The natives of Cordofan, as well as of Caffraria, the Batokas, Ovampos and the Soudan tribes are expert in producing the best descriptions of wrought-iron and steel from the ores by the most simple means, and in making an appropriate use of them. In this manner an iron industry of some importance has arisen amongst the Batoka tribe on the Zambesi, around the Nyanza lakes, and in Usanga on the eastern coast.

The length of railway lines completed in Africa at the end of 1877 was 3,255 kilometres, viz.:—

| | | |
|---|---|---|
| In Egypt | 1,763 | kilometres. |
| „ Tunis | 60 | „ |
| „ Algeria | 682 | „ |
| „ Cape Colony | 644 | „ |
| „ Mauritius | 106 | „ |
| Total | 3,255 | kilometres. |

Several projects have lately been brought forward for the purpose of laying down a line from the northern coast to Central Africa, by which the inhospitable Sahara would accordingly be traversed, with a view of rendering the rich natural produce of the Soudan more accessible. One of the two projected lines would start from Algeria and terminate at Timbuctoo. The other project, which is evidently more feasible, and is strongly recommended by the explorer MR. ROHLFS, consists in connecting the towns of Tripolis and Kuka by a line. This vast project would, if realised, evidently be of the greatest importance to the commercial intercourse between Europe and Central Africa; but for a long time to come the traffic will be confined to the present means of transport by caravans, as the construction and working of this Central African line would be very difficult in the first instance, in consequence of the general scarcity of coal

in the territories concerned, and secondly, but not in an equal degree, of the scanty supply of water, the frequent sand drifts, and the hostile disposition of the natives of these parts.

## EGYPT AND HER VASSAL STATES.

Apart from some soda, saltpetre, alum, and sulphur works and quarries, mining may be said not to exist at all in Egypt.

A seam of coal, which has been discovered in the oasis of Ghenne, between the years 1840 and 1850, has not been worked. The consumption of coal, however, is very considerable. The import at Alexandria, amounting to about 125,000 metric tons in 1865,* had increased to about 200,000 metric tons in 1870, and in the same year 125,000 metric tons were imported at Port Said. The price per metric ton of coal delivered at Alexandria, at the usual rate of freight, and all costs included, was 34s. 6d. to 36s. Almost the whole import is supplied by England.

Iron is not produced in Egypt, only imported iron being worked there in exceedingly small quantities. Thus, for example, only 360 metric tons of iron were used in 1872 by 83 foundries in Cairo, and by 6 in Alexandria, and only 52 metric tons by the small arms manufactory of the latter place.

The value of the *hardware* import of 1865 was, according to the most detailed returns available, £174,486, 85% of which was imported from England or by English agents.

In *Nubia* mineral fuel is said to have been discovered in the vicinity of the first cataract of the Nile.

The bog ore deposits of the sandy plains and argillaceous strata of northern *Cordofan* are of some importance for these parts, as the natives make their iron from it.

When M. SCHWEINFURTH was travelling in 1870 and 1872 among the Neam-Neam and Minbuttoo tribes in the district of the western tributaries of the Nile, he repeatedly found bare and far extending plains of coarse grained bog ore. They are a peculiar feature of the entire district of the Bahr-el-Gazal and of the southern portion of the wide alluvial plain inhabited by the Dinka tribe, and sometimes extend, without interruption, for miles. He also found there considerable deposits of brown ironstone. Magnetic ores have been found in the mountainous Bari district, and iron and copper ores in *Darfur*.

## ABYSSINIA.

A highly trustworthy gentleman, Major W. CORNWALLIS HARRIS, who has spent sixteen months in these parts, some years ago adduced convincing evidence of coal existing at a distance of 650 kilometres from the port of Tajurra, on the Red Sea. The same gentleman assures us that coal strata extend along the entire eastern frontier of Shoa, but the combustible properties of this mineral are not known to the natives. Some large lignite deposits, which however are not worked, have been found in the Goáng valley, between Dembra and Tshelga. Considerable quantities of iron are also said to exist in these territories, chiefly in Tigrié and Shoa, on the Tohad river.

## EASTERN AFRICA.

LIVINGSTONE found large quantities of coal, which to all appearance had been washed off and drifted away by water, scattered along the bed of the Ruvuma river in the Niare district. He likewise discovered a great number of coal-seams cropping out near Tete, on the Zambesi river, from which he was induced

* The exact figures are 117,722 metric tons, of the value of £223,900; 103,403 metric tons, value of £188,007, came from England.

to believe in the existence of an extensive and productive coal-field north of the Zambesi. But these treasures can hardly be expected to be raised for some time to come. Livingstone also found an abundance of iron-ores in the territories explored by him. Coal is also found in *Mozambique*.

## SOUTHERN AFRICA.

In the *Cape Colony* coal-seams have already been discovered at numerous places. Mr. RICHARD BRIGHT, who is well-known by his explorations of these parts, in the summer of 1873 likewise discovered coal in *Basuto-land*, which has lately been annexed to the British possessions, near to the junction of the Great and the Little Caledon rivers. The seams are intersected by layers of shale and sandstone, and are not sufficiently thick to be worked with profit. Neither is the coal suitable for coking, but the discovery of better seams is anticipated. Exhaustive trials of this coal were made at the Capetown gasworks. Coal-seams were likewise discovered at Pieter-Maritzburg, in *Natal*. The value of iron and hardware imported from England into the British possessions of Southern Africa, in 1875, was £603,308.

## WESTERN AFRICA.

Not only the Portuguese province of *Angola* but also entire Upper and Lower Guinea and Senegambia are well provided with iron ores.

In the last-named territory, chiefly the mountain district of the Mandingos, on the Upper Senegal, and the Bondu country are rich in iron ores. DU CHAILLU admired the skill in iron working exhibited by the Fan tribe on the Gaboon river, in Southern Guinea. Iron ores are cropping out at the surface at many places in these parts. The natives are in the habit of piling up a stack of charcoal and ores, which is ignited and kept in this state until the iron oozes out. This product is converted into malleable iron and steel by means of reheating and hammering, and in this state preferred even to the European manufacture.

## MOROCCO.

The geognostical configuration of this country coincides exactly with that of southern Spain. Thus, for example, the resemblance of the Gibraltar rock to those on the opposite African shore is quite striking. The Rif (coast district) chiefly consists of limestone rocks. The slaty and easily decaying marl is the cause of the great fertility of the plains. On the southern coast of the Atlantic yellow sandstone is frequently found. Of the geological structure of the Atlas mountains hardly anything is known.

As to the existence of *coal* we are likewise entirely ignorant. Besides, a great portion of the Atlas range and the Rif are covered by innumerable virgin forests, on account of which the use of mineral fuel must be entirely out of question for some time.

*Iron* seems to be the most common of all metals there. It is found in many places in a metallic state, and the entire range of the Atlas has an abundance of it. Near to the Wad-un-Ausud river a spring containing iron has been discovered.

Iron ores were mined in Morocco long before the time of the Carthaginian rule. These old workings may be traced even now on the foot of the Djebel Hadyd 25 kilometres distant from Mogador. Some projects of working the rich ore deposits of the country were entertained in England, but nothing concerning their realisation has been reported.

## ALGERIA.

Owing to the geological structure of Algeria the existence of *coal* deposits there is open to doubt, at least as far as the cultivated portion of this country is concerned. Of late however some geologists in the service of the French

Government have succeeded in discovering coal in the more remote parts of the country. This discovery is of enormous importance, especially for Algeria. The country is well known for its abundance of ore, of which two descriptions are found, corresponding to the Swedish and the Elba ores. In 1870, 70 ironstone mines had been concessioned in Algeria, of which however only 10 had been actually worked, the value of their output being £80,000. The existence of sufficient coal deposits would accordingly be indispensable for the development of the iron industry.

Extensive lignite deposits are found at Smendu, in the province of Constantine; likewise at Goleah. The Smendu basin is 140 kilometres distant from Constantine, and 273 kilometres from the sea. The Goleah coal appears to be of good quality, but the contents of this basin are not considerable. A quantity of 86,448 metric tons of it was exported during 1875 by a French company, which is also engaged in oremining near Bona.

The centre of Algerian *iron* mining is Ain-Mokta (Mokta-et-Hadid), on the Fezzara Lake, at about 30 kilometres distance from Bona. The mines at this place are leased to a French company. Considering the great increase of the output of the inexhaustible ore deposits in northern Spain, due to the cessation of the civil war in that country, we are induced to share M. ROCOUR'S opinion, that the export of Algerian ores to the Mediterranean ports will in the course of time be restricted to some extent. This appears to be all the more likely, if we consider that up to the present the mining operations have only been carried on in the outcrop of the ores, and that for a continued large output expensive works are becoming necessary, in order to reach the lower seams. The French company above mentioned, having raised about 3 million metric tons of ores altogether, has already commenced underground workings in 1874.

The quantity of ores raised at Mokta was:—

| | | |
|---|---|---|
| In 1875 | 418,868 | metric tons. |
| „ 1876 | 388,802 | „ „ |

A great portion of this output was shipped in the port of Bona to France. The stock of ores raised at Mokta in March, 1877, was 126,000 metric tons. If in the course of some years the difficulties in the way of mining operations increase and the profits accordingly decline, the company will most likely abandon the present workings and look out for other places where mining may be carried on under more favourable conditions. These will be found without difficulty, as great quantities of excellent ores have been proved to exist in many other localities within the colony.

Other companies besides the former have been constituted for the purpose of oremining in Algeria, but they have not been equally successful. Generally speaking, all of them were working more briskly in 1876 than previously.

According to the official returns, the following quantities of iron ores were exported from Algeria:—

| Year. | Quantity. Metric Tons. | £ Value. |
|---|---|---|
| 1850 | 89,125 | 15,049 |
| 1860 | 69,391 | 27,757 |
| 1870 | 84,714 | 338,858 |
| 1871 | 86,166 | 344,665 |
| 1872 | 195,594 | 782,379 |
| 1873 | 210,347 | 269,245 |
| 1874 | 230,136 | 294,574 |
| 1875 | 261,315 | 334,483 |

The total output of all the 14 mines of Algeria is estimated at 600,000 metric tons per annum. The number of hands returned for 1876 is 4,311.

The Algerian ores are of the greatest importance to the French iron trade, as the

*

manufacture of the best descriptions of iron is based upon them. A portion of the Algerian ores is sent to England and the Low Countries, and another, though of much smaller extent, to the United States.

The only Algerian ironworks worth mentioning are at Atélik near Bona, where pig-iron is made from spathic ore by coke from Edough and Ben Salah coal.

The import of iron and steel hardware in 1875 was 9,134 metric tons, of a value of £162,654.

The length of the railway lines opened to traffic in Algeria was 682 kilometres in 1877, a length of 325 kilometres being in course of construction.

## SAHARA.

The Sahara in its entire extent is quite devoid of iron and of coal. The geological configuration of it is as follows: Plains of gypsum mixed with earthy substance in horizontal layers; low hills covered by hard gypseous rocks of dense texture; scales of crystalline gypsum, marl, clay, and, above all, fine grained sand showing only traces of oxide of iron.

## THE SOUDAN.

The Mandara hills, to the south of Lake Tchad, are prominently rich in iron ores, from which a very fair description of malleable iron is made, which is a somewhat important object of trade in the southern parts. The neighbouring Mora district is much frequented by the natives on account of the excellent description of hardware which is manufactured there.

## THE ISLANDS.

*Madagascar* is said to be abundantly provided with iron and coal.

On the island of *Mauritius* a ferruginous sand is found, but mining and smelting works do not exist. The coal wanted for sugar boiling is imported from England.

The following table contains the export of British coal to Africa in 1875 :—

| | Quantity. Metric Tons. | £ Value. |
|---|---|---|
| To Egypt | 535,692 | 396,963 |
| „ Tripoli and Tunis | 2,914 | 2,194 |
| „ Algeria | 25,842 | 15,846 |
| „ Morocco | 264 | 232 |
| „ Western Africa | 56,110 | 43,594 |
| „ Ascension Island | 3,492 | 2,538 |
| „ St. Helena „ | 1,526 | 1,214 |
| „ British South Africa | 48,345 | 36,934 |
| „ Eastern Africa | 11,549 | 9,319 |
| „ Abyssinia | 1,964 | 1,250 |
| „ Madagascar | 457 | 315 |
| „ Mauritius | 25,566 | 2,310 |

# AUSTRALIA.

8,865,684 SQUARE KILOMETRES. 4,748,600 INHABITANTS.

COAL and iron are found scattered all over the Australian continent; the thickness of the seams however, as well as the value of their contents, is very variable. Wherever inexhaustible deposits of precious metals are found, coal and ironstone mining will, as a matter of course, be neglected; and where this formidable competition does not exist in Australia, the iron and coal industries are obstructed by other impediments.

At the end of 1877 the following lengths of railways were opened on the Australian continent :—

| | Kilometres. |
|---|---|
| In New South Wales | 920 |
| „ Victoria | 1,292 |
| „ South Australia | 597 |
| „ West Australia | 61 |
| „ Queensland | 451 |
| Total | 3,321 |

## NEW SOUTH WALES.

If South Australia is frequently called the copper and Victoria the gold country, New South Wales deserves the name of the *coal* country.

The coal deposits are extending from the northern frontier of the colony to 35° of southern latitude over a vast superficial area, approaching the sea-coast, reaching westward to the eastern slope of the Blue Mountains, and being computed at no less than 64,250 square kilometres.

This vast coal district is intersected for a length of 156 kilometres by two railways, the Great Southern and the Western Lines, both starting from Sydney; the first running through the district as far as Marulan, the second as far as Rydal. Lastly, the Northern Railway, beginning at Newcastle, extends along these rich coal deposits up to Murrurundi at a length of 193 kilometres.

The seams are up to 3 metres thick, inclusive of the interposed bands of shale, &c. The quality of the coal is known to be excellent. It is highly suitable for coking, and not inferior to the best English descriptions. A free use of it is chiefly made by steamers, and on board of Her Majesty's vessels stationed in Australia it is consumed exclusively. Apart from the Australian colonies it is exported in great quantities to the South Sea (New Zealand), California, Valparaiso, China, Japan, Singapore, Bombay, Calcutta, Java, Ceylon, and Mauritius.

In the year 1829 we find coal returned for the first time among the products of the colony. There had then been raised in the Newcastle district 780 metric tons, of a value of £385. At that time the whole traffic between Sydney and Port Hunter was carried on by a single cutter of 80 tons. At present the

port of Newcastle is, next to that of Sydney, the most important of the colony, and about 1,050 large vessels (besides the coasting craft) annually sail with cargoes of coal for other colonial or foreign ports.

The most important of the coalmines are those extending from Newcastle to Maitland and Singleton on the Hunter river. Their present number is eleven.

The following quantities of coal were exported from Newcastle :—

| | | | | | |
|---|---|---|---|---|---|
| In the year 1870... | 743,795 | metric tons. | In the year 1874.. | 1,117,345 | metric tons. |
| „ 1871... | 768,676 | „ | „ 1875.. | 1,160,278 | „ |
| „ 1872... | 870,700 | „ | „ 1876.. | 1,130,683 | „ |
| „ 1873... | 963,510 | „ | | | |

At present, 7 coalmines in the southern and 4 in the northern district are being worked. Owing to the Great Western Railway being already laid down to Orange (312 kilometres), the latter are likely to be rapidly extended.

The quantity of coal raised from 1829 to 1876 was 15,036,776 metric tons, of a value of £8,095,998. The rapid increase of the mines will appear from the following returns of production :—

| Year. | Output. | Value in £ Sterling. | Year. | Output. | Value in £ Sterling. |
|---|---|---|---|---|---|
| | Metric Tons. | | | Metric Tons. | |
| 1830... | 4,000 | 1,760 | 1870... | 868,564 | 309,866 |
| 1835... | 12,392 | 5,362 | 1871... | 898,784 | 309,381 |
| 1840... | 30,256 | 16,135 | 1872... | 1,012,426 | 387,970 |
| 1845... | 22,324 | 8,576 | 1873... | 1,192,862 | 651,101 |
| 1850... | 71,216 | 22,860 | 1874... | 1,304,567 | 772,839 |
| 1855... | 137,076 | 87,122 | 1875... | 1,329,729 | 801,402 |
| 1860... | 368,862 | 221,510 | 1876... | 1,319,918 | 785,627 |
| 1865... | 585,525 | 268,268 | ... | ... | ... |

In the year 1872 the number of workmen in the Australian mines was 3,407.

The official reports of the colony are certainly justified in stating that New South Wales is in possession of the richest and most extensive, as well as the best accessible, coal deposits of the southern hemisphere ; and that, owing to them, this colony will in the long run be the greatest and richest amongst the Australian colonies. It is further stated that the bituminous and half-bituminous splint and anthracite coal and cannel of this colony are, as regards heating-power and quality, not inferior to any coal extant ; and that the numerous deposits of petroleum-cannel, which is equally suitable for the production of gas and of very serviceable mineral oils, are not equalled anywhere.

The most excellent petroleum-cannel of the world is raised at the Hartley Colliery, on the Great Western Line, at a distance of 136 kilometres north-westward from Sydney. One metric ton of it yields from 681 to 727 litres of crude oil and 576 cubic metres of gas of 40 standard candles illuminating power. Large quantities of it are sent to the gasworks, not only of the neighbouring colonies, but also of China, San Francisco, &c., where it is mixed with other coal for increasing the illuminating power of the gas.

The entire production of cannel and bituminous shale in New South Wales in 1876 was 15,998 metric tons of a value of £46,419, of which by far the greatest portion was raised at the Hartley Colliery.

The *iron-ore* deposits of New South Wales are, according to geological researches, quite inexhaustible. They are, however, only worked to a very slight extent. Some very valuable ore-beds have already been opened, and will yield a fair output as soon as sufficient hands are available. The ores of the Mittagong mines are nearly pure oxides like those in Sweden, and of prime quality. Not far from Wallerawang, on the Great Western Line, 245 kilometres-westward from

Sydney, there are enormous deposits of the richest ores (principally hematite) and of limestone, within a circle of 6 kilometres diameter, which are intended to be worked by the newly-constituted Wallerawang Iron and Coal Company.

The ore deposits lately discovered on the southern coast, about 30 kilometres from Jervis Bay, are no less important. These ores contain up to 51½% of metallic iron, and are found together with limestone and coal seams.

The North Bulli Coal and Iron Estate, likewise situated on the southern coast, has an enormous deposit of clay ironstone at its disposal, which contains from 32 to 55% of iron. Iron ore seams of great thickness were also discovered below copper ores, near Carcoar, on the Belubula River, 282 kilometres westward from Sydney.

The iron ore mines of the Fitzroy Bessemer Steel, Hematite, Iron and Coal Company, near Nattai, on the Great Southern Railway, 126 kilometres from Sydney, are the most extensive and important of the entire colony. This district shows great abundance of deposits of rich iron ores as well as of coal and limestone. At the Nattai blast-furnace 10 tons of pig-iron were made from 18·8 tons of these ores. The fuel consisted of a mixture of coke and anthracite. In 1876 this furnace produced 2,679 metric tons of pig-iron, of a value of £13,104, a quantity which could easily be considerably increased. 50 metric tons of this pig-iron went to St. Francisco. The number of workmen amounted to 70. Lately this company has decided to erect a rolling-mill.

The quantity of iron exported was only 40 metric tons, of a value of £491, in 1875; and 482 metric tons, of a value of £3,368, in 1876; but the next years are certain to exhibit a considerable increase of this quantity.*

## VICTORIA.

Goldmining has caused the rich treasures of coal and iron ores possessed by this colony to be neglected. In the year 1876 iron and hard ware of all descriptions were imported into Victoria from England, having a total value of £1,174,374. The whole yield of iron ores during 1874 was confined to 130 metric tons.

At Castlemaine, 223 kilometres south from Bendigo, the third greatest town of the gold region, there is a foundry where 100 men are employed. At Melbourne there is quite a number of foundries in brisk activity.

## SOUTH AUSTRALIA.

The immense quantity of copper ores in this colony is an impediment to all other mining enterprise. In the year 1877 a discovery of important coal deposits was talked of, but up to now all news referring to the same appears to have been founded on self-deception.

South Australia is said to possess extensive and valuable iron ore deposits, but their existence has only been proved beyond doubt in the vicinity of the port of Wallaroo. Only lately the South Australian Government has contracted in England for the delivery of 26,00. metric tons of iron and steel rails.

## WEST AUSTRALIA.

Of the mineral wealth of this colony only very little is known as yet. The northern district, discovered by Sir GEORGE GRAY in 1839, is of particular importance. It is situated between the Murchison river, in 27° 50′ of southern latitude, and the Upper Irwin, at 300 kilometres from the sea, and contains amongst other minerals great quantities of coal and iron. As far back as in the year 1846, two seams of coal, of 2 and 2·5 metres thickness, were found here. Coal has also lately been discovered at a distance of 300 kilometres from Champion Bay.

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* H. GREFFRATH, Die Colonie Neu-Süd Wales in ihrer mineralischen Bedeutung.

## QUEENSLAND.

Iron and coal are found at different places, but do not meet with any consideration in consequence of the abundant quantities of gold, copper, tin, and galena, of which this colony is very rich. The coalmines yielded an aggregate of 33,500 metric tons in 1875.

During 1875 a deposit of excellent coal, allowing a considerable output, has been discovered on the River Logan. This coal might easily be exported by sea, if a connection with Moreton Bay could be established.

## TASMANIA.

This island possesses very rich coal deposits, extending nearly over its entire area. Workings, however, have only been opened very recently, as the seams were investigated and their extent defined only about 1860, by Mr. GOULD, a young geologist. Before that time only a few seams cropping out near the principal town of the island were worked. Mr. Gould, however, proved the existence of far better seams in the ranges of hills near Nicholas and Killymoun, some of them having a thickness of more than 2 metres for a length of 15 to 20 kilometres. They are also most advantageously situated in the immediate vicinity of the seaports. In 1875 there were 4 mines in Tasmania, yielding an aggregate of 7,719 metric tons.

Iron ores are likewise found on the island. A furnace was blown in by the Tamar Hematite Iron Company in the beginning of 1875, and as it proved a success, the erection of another was immediately commenced.

At the end of 1877 Tasmania possessed 250 kilometres of railway lines.

## NEW ZEALAND.

Here, too, gold-washing bars all other mining enterprise. Coal deposits have been discovered at several places of the northern and southern island, as, for instance, the north-eastern portion of the province of Auckland and in the north-western part of Nelson, where workings have already been opened in some seams that were cropping out at the surface. Important seams of coal have also been discovered in the carboniferous sandstone of the Papahaua mountains on the western coast of the southern island. The southern portion of the Paparoha mountain contains valuable coalmines. Lastly, carboniferous sandstone containing rich seams of coal is found in the eastern portion of the southern Alps and along the whole southern coast of the province of Otago.

Iron ores are not wanting in New Zealand either. Ironworks were erected at Taranaki by the Titanic Steel Company, but no report of the production is extant. The value of English iron exported during 1875 to New Zealand was £1,265,000.

The entire length of the railway lines of this colony at the end of 1877 amounted to 1,137 kilometres.

Coal is said to have been discovered also on the *Chatham Islands*, at no great distance from New Zealand.

## NEW CALEDONIA.

The crew of the brig Prony, which in 1854 took possession of New Caledonia in the name of France, discovered a seam of coal in the beautifully situated bay of Moaré, from which they supplied their store, the coal being of the best quality. Even at present, however, coal is imported from France.

Iron ores are found in great quantities in the South Bay of the Island of Uën, as well as all over the southern part of the main island, near Unia, in Massacre Bay, &c. It is believed that the iron ores found here may become very important. They contain 2 per cent of chromium, but the steel made from them, which can be got free of this substance, loses nothing of its ductility, and is extremely hard.

# ARCTIC TERRITORIES.

THE most northern of all coal seams known at present is that found by the Discovery, during the British Expedition of 1875, in the bay named after her, on the western side of the Robeson Channel, in the extreme north of *Greenland*, at 84° 44′ northern latitude, and 65° 3′ western longitude. The seam strikes from east to west, and is contained between strata of clay-slate. The coal is a glancing pitch coal, and very brittle. It has been proved by analysis to be of the same composition as other first rate bituminous coal. It is similar to several English descriptions, especially to Chesterfield coal, and yields 65% of coke. The small quantities for the use of the expedition were got from an open working. This deposit may become very important to future discoverers, especially to the ballooning expeditions, which have already been proposed more than once, and which could be supplied with gas from it.

Coal has also been known to exist for a long time in *Spitzbergen*, but more accurate reports concerning it have only been given by the last scientific expeditions. A coal seam of considerable thickness has been found cropping out at five different places in King's Bay.

Lastly, a tertiary lignite-bearing sandstone has been proved to exist in *Kaiser Franz-Josef-Land*, by Mr. PAYER. Lignite, however, has been found there only in insignificant quantities.

John Heywood, Excelsior Printing and Stationery Works, Hulme Hall Road, Manchester.

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# LIFE INSURANCE.

A SERIES OF LETTERS HAS APPEARED IN THE COLUMNS OF THE *TIMES* complaining *inter alia* of offices either declining to revive Policies that had lapsed, owing to non-payment of Premium, or insisting upon fresh medical examination.

## QUEEN INSURANCE COMPANY.

A portion of one of the conditions endorsed on the Policies of this Company is as follows: "Policies for the whole term of life, on which the premiums have been paid for five years, will be revived by the Directors during any period within twelve calendar months from the last of the days of grace, on payment of the arrears of premium, together with a fine not exceeding Two Shillings and Sixpence per cent per month on the sum assured."

**It will be observed that under this condition no fresh medical examination is required by the Queen.**

## AS TO SURRENDER VALUES.

The ordinary whole Life Policy holders of the QUEEN *can themselves determine the minimum amount that would be allowed for the surrender of their Policies*, seeing that another condition endorsed on the Policies is to the effect that if two full years and upwards in force, a return at any time thereafter may be demanded, while the Policy is in existence, of not less than 35 per cent of the premiums paid.

**The Life Fund represents 66·1 per cent of the entire premiums received on every Policy in force.**

## FUNDS.

| | |
|---|---|
| **Capital Paid-up** | **£180,035** |
| **Reserve Fund and Suspense Account** | **280,000** |
| **Balance Fire Account** | **16,243** |
| **Life Assurance Accumulation Fund** | **252,609** |
| **Annuity Fund** | **8,491** |
| **The Income of the Company is now** | **£493,120** |
| **The Company has paid in satisfaction of claims** | **£2,056,890** |

J. MONCRIEFF WILSON, *General Manager.*
T. WALTON THOMSON, *Sub-Manager.*

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